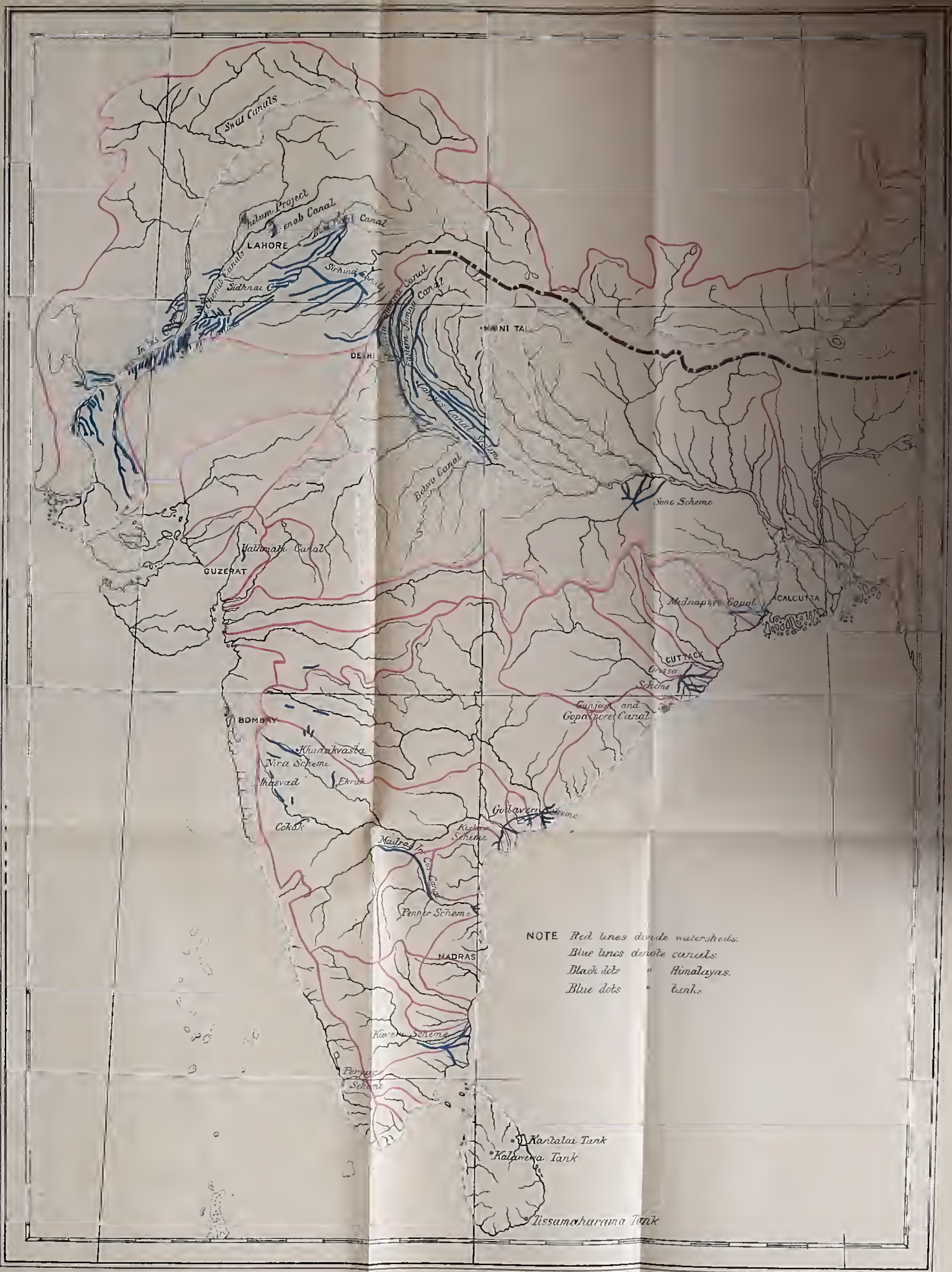

Swat Canals
LAHORE
Sidhnai C.
DELHI
Eastern Jumna Canal
Ganges Canal System
Betwa Canal
Sone Scheme
GUZERAT
CALCUTTA
CUTTACK
Orissa Scheme
BOMBAY
Khadakvasla
Nira Scheme
Gokak
Penner Scheme
MADRAS
Kantalai Tank
Kalawewa Tank
Tissamaharama Tank
NOTE Red lines divide watersheds.
Blue lines denote canals.
Black dots " Himalayas.
Blue dots " tanks.

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IRRIGATED INDIA

AN AUSTRALIAN VIEW OF INDIA AND CEYLON

THEIR IRRIGATION AND

AGRICULTURE

BY THE

HON. ALFRED DEAKIN, M.L.A.

Formerly Chief Secretary and Minister of Water Supply of Victoria, Australia

WITH A MAP

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1893

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AUTHOR'S PREFACE.

THE present work is a recast of a series of newspaper articles, the product of a tour through India in the cold weather of 1890-91, undertaken at the suggestion of Mr. David Syme, proprietor of the Melbourne *Age*, in order to afford to the Australian public, interested in irrigation, a sketch of what is being accomplished by its means in the peninsular empire of Southern Asia. It proved impossible to do this intelligibly without indicating in outline the circumstances of the country and its people, novel to colonists, unique in history, and important to all subjects of the Queen. The past as root of the present, and the present in its political, social, and religious aspects are, therefore, rapidly reviewed in the opening chapters. The physical and other conditions of the several Presidencies are next glanced at, the general character and prospects of native agriculture noted, and some chief irrigation schemes, with their lessons, briefly described. Detailed summaries of the achievements of the several Irrigation Departments and their financial results, proportionately of considerable length and in some parts a little technical, are added as an Appendix.

This volume makes no pretence to adequacy of treatment, even of its special subject. The writer is not an engineer, but having held the portfolio of Minister of Water Supply in Victoria for several years, and having in that capacity reported upon the systems of artificial watering in vogue in the United States (1885), Egypt and Italy (1887), he has gathered a sufficient acquaintance with them to become convinced of their applicability to Australian soils and climates. Both in this relation, and in his treatment of other questions relating to India, he has suited the manner of his comments, so far as he was able, to the miscellaneous audience addressed through the daily press, not hesitating to pass judgment upon the gravest issues with an easy infallibility that is almost editorial.

That many parts of the interior of the Australian Colonies need the application of water to the land to ensure success in agriculture and horticulture, and to improve pasture, has been demonstrated only too often by the rigours of recurring droughts. The fact that Victoria, South Australia, and Queensland have already legislated, while New South Wales is upon the point of legislating, to provide for irrigation in arid districts is an official recognition of the need. There are at least 10,000,000 acres on the continent commanded by water supplies ample for the maintenance of schemes such as those of Bombay, the Panjab, Southern California, Utah, or Colorado: within the next few years it is certain that several hundred thousand acres will be regularly cultivated by these means, and, judging by the experiments already instituted, with returns as large as have been obtained in the most favoured localities of the old or new worlds. Any contribution to the study of irrigation, or exposition, however cursory, of its methods elsewhere is of possible value at the present time.

Apart from this, the future relations of India and Australia possess immeasurable potencies. Their geographical proximity cannot but exercise a very real and reciprocal influence upon the forces of national life in each, presenting to both vital problems of common interest, and possibilities of political development as vast as they are vague. The reference to such topics in these pages is slight and incidental, intended to serve as the rudest of finger-posts to such of the writer's fellow-countrymen as take a thoughtful view of their responsibilities and cherish a high ideal for the coming Commonwealth.

The writer expresses his great obligations to His Excellency the Marquis of Lansdowne, Viceroy of India, to Lord Harris and Sir James Lyall for their generous hospitality, and to their Excellencies the Earl of Hopetoun and Sir Henry Norman for letters of introduction which proved of high value. The purpose of his visit was greatly assisted by the kindness of Colonel Ardagh, private secretary to the Viceroy, Colonel Forbes, chief engineer of irrigation to the Central Government, Colonel Ottley, assistant secretary of public works, and chief of the Irrigation Department of the Panjab, Mr. G. T. Walsh, chief engineer of the Madras Presidency, Mr. C. T. Hughes, chief engineer of the Bombay Presidency, Colonel Neill, chief engineer of Bengal, Colonel Harrison, chief engineer of the North-west Provinces, Mr. R. McBride, chief engineer of Ceylon, Mr. A. G. Reid, C.M.G., C.E., Mr. T. Benton, C.E., Mr. E. Price, chief secretary of Madras, Mr. R. Blechyngen, secretary of the Agricultural

Society, Calcutta, Mr. D. P. Masson, of Lahore, Mr. A. W. Ferguson, of Colombo, and Mr. Herbert Syme, his comrade in the tour. He has to thank Mr. David Syme, proprietor of the Melbourne *Age*, the proprietors of the *Daily Telegraph*, Sydney, and Messrs. Burden and Bonython, proprietors of the *Advertiser*, Adelaide, for permission to republish the articles which appeared simultaneously in the three journals above-named.

To the Right Hon. Sir Charles W. Dilke, Bart., M.P., and Mr. Philip Mennell, of London, he is under heavy obligations for their friendly services in seeing the work through the press.

Melbourne, *Sept.* 1892.

PREFACE TO THE ENGLISH EDITION.

It may safely be said that the component parts of the Empire know too little of each others' idiosyncrasies and achievements. There is no need to go from under the shadow of the British flag in search of precedents for grappling with the complexities which confront the pioneers in the later developed areas under the Imperial rule. To a large extent, even on the continent of Australia, the several colonies carry on their experiments, social and economical, as though they lay abreast of alien communities, of whom pride and patriotism forbade them to learn. Federation will shortly, it is to be hoped, eradicate this fatal provincialism. And in the meantime all honour is due to those who possess sufficient individuality to break through an insularity, which having no warrant from antiquity, is vastly more absurd than that of our tradition-haunted island.

Mr. Deakin taught and—he would admit—learnt much during the time when he figured before the British public—or before that small portion of it which pays any heed to Imperial questions—during the era of what red-tapists style the "Colonial," but what those of wider vision rightly misname the "Imperial Conference of 1887."

Having acquired this lesson in cosmopolitanism, Mr. Deakin, whose future rests on the fact that he, best of all Australasian politicians, realises the truth that on the development of the internal and interior resources of the Australian Continent, and not on loan-mongering and land-booming, depends its future status as an autonomous member of the Imperial comity, recently made an observatory tour of the great irrigational works of India, the result of which is embodied in the following pages.

As the sponsor of Irrigation in Australia, Mr. Deakin has thus reinforced the arguments based on local circumstances, and illustrated by American models, with comparisons drawn from the experiences of the greatest irrigating country in the world, and that too included within the bounds of the all-climate, all-condition embracing, British Empire.

For English readers the chief interest of the book, outside of expert information, must lie in the fact that it presents an outsider's view of the work, which, largely oblivious of the economic theories which pass current as axioms at home, the British rulers of India have brought into play for the fructification, and even salvation, of their great trust towards the subject myriads of India.

To avoid misconception, the English reader must bear in mind that Mr. Deakin writes from an Australian standpoint, viewed occasionally through purely Victorian spectacles, and that for some anachronisms the fact that the articles upon which the work is based were written in the winter of 1890-91, must be accepted as sufficient apology.

There is one technical expression which Mr. Deakin in several instances makes use of, which may puzzle the general reader. It may, therefore, be explained that the term referred to—"the duty of water"—implies the area of land which a given quantity of water will irrigate. As Mr. Deakin himself puts it in a previous work on American Irrigation: "The quantity of land which any given unit of water will irrigate is governed, first, by the kind of soil, subsoil, the rainfall, temperature, and evaporation of the particular area irrigated; next by the kind of crop grown, and the method of watering it, as well as by the length of time which that land or neighbouring land has been irrigated: and lastly by its position with regard to seepage and its capacity of capillary attraction."

P. M.

London, *Dec.*, 1892.

CONTENTS.

CHAP.		PAGE
	Introduction—India and Australia	9
I.	The British in India	17
II.	The Native Population	30
III.	Physical and Political Divisions	56
IV.	Ceylon	63
V.	Madras	73
VI.	Lower Bengal	80
VII.	Bombay	86
VIII.	The Independent States	94
IX.	The North-west Provinces and the Panjab	103
X.	The Agriculture of India	113
XI.	Indian Wheat and Australian Trade	131
XII.	Irrigation Generally	141
XIII.	The Kaveri Scheme	153
XIV.	Ekruk and Khadakvasla	161
XV.	Powai, Vehar and Tansa	169
XVI.	The Ganges Canal System	176
XVII.	The Bari Doab Canal	191
XVIII.	The Sirhind Canal	208
XIX.	Indian Irrigation	225

APPENDICES.

I.	Irrigation in Ceylon	239
II.	Irrigation in Madras	252
III.	Madras Company's Canal	264
IV.	Irrigation in Bombay	270
V.	Irrigation in Lower Bengal	277
VI.	Irrigation in the North-west Provinces	291
VII.	Irrigation in the Panjab	301

IRRIGATED INDIA.

INTRODUCTION.

INDIA AND AUSTRALIA.

Who would comprehend the interest which India has for Australia, must first understand the interest which it has for the rest of the world. This is unique, and inexhaustible, and of many phases. The first place in the visitor's curiosity is usually occupied by the external aspects of modern native life, and some architectural remains, which attest the power, opulence, and artistic taste of one or two epochs, in as striking a manner as even Egyptian ruins, or those later and more exquisite fragments which exhibit—

> The glory that was Greece
> And the grandeur that was Rome.

But there is much besides, vaster, more profound, and more pregnant in appeal to the thoughtful. The aspects of Nature are varied and magnificent, embracing every kind and class of spectacle, from soils fat with the recuperative fertility of inundations, to desert wastes of scorching, dun-coloured sand; from cosy, homely nooks of fruitful village fields, to sterile, rocky peaks, and fathomless depths of inaccessible gorges; from over-populated, ever-cultivated river flats, sparsely settled plateaux, and savage-haunted jungles, to craggy wastes, untenanted save by some lonely herdsman, fierce refugee, or sad, outcast clan. Indeed the beauties of many climes and countries are scattered profusely throughout this mighty peninsula, limb-like rooted in its socket, so near the heart of Asia, and so magnificently mountain jointed.

Less grand, less inspiring, but as various, and more intimately interesting to most tourists, are the multitudinous branches of the human family whom it maintains in one or other of its regions, offering an infinite wealth of illustration and suggestion to the anthropologist, historian, philanthropist, and to all seekers amid the

embers of the past for the far off origins of race, language, and religion. Then there is that great political marvel—the British raj—little more stable than in the days of Clive, though immensely expanded and more highly organised. If the Eurasians, or half-breeds, at present a despised and insignificant body, could transfuse the Caucasian capacity for self-government into a new native caste, or carry into European families a sufficient strain of Hindu blood to render them climate proof, and capable of permanent residence, there would be a brighter outlook for the future. As it is, Mr. Meredith Townsend's warnings are most timely; the gulf between the two peoples is deepening, if not widening; and the glacier-like advance of the forces of the White Czar has brought them at last within hail of the gates of India.

Another interest should be the irrigation system—bold, comprehensive, and original—by which millions are fed, a monument to the sagacity, ability, and magnanimity of British rulers. This until now most travellers have carelessly passed by. The writer was the first civilian unconnected with the Government who had ever taken the pains to visit the Sirhind Canal, and other important works, which should be the admiration of thousands. Railways of equal and even greater size, and of equal, if not superior, efficiency, we can see elsewhere, but there is not a canal system in the world to compare with that of India. Yet even to the people who created this system it is as if it were not, "as if it could not be, as if it had not been," so little do Anglo-Indians know about it. When the reproach of ignorance and indifference shall have been removed, critics will undoubtedly award this achievement of British engineers its fitting place in the scale of their interest and attention. To describe it without technicality is the main object of this book, though it touches perfunctorily upon other chief features of the country, sufficiently it is hoped, to render its past and present intelligible to the colonial readers to whom it is primarily addressed.

There are other present-day interests which can only be glanced at in passing. Unquestionably the fame and fortunes of England are staked upon the control of this peninsula. While India is kept intact, the British Empire remains a power of the first rank. If India falls under a foreign yoke, the prestige and influence of the nation fall with it, never to rise again, unless, indeed, the balance be redressed by the growth and cohesion of colonies which have become commonwealths, dominions, and federations, by whose might and influence the globe will be ringed, and girdled from sea to sea. Meanwhile, within the country, problems multiply apace—problems which go to the root of national and political life, and exhibit in full play the seminal principles upon which our whole social order is founded The limits of authority, and rights of citizens, the sway of conscientious despotism, and demands of a coloured democracy, the strength of hydra-headed superstitions, tenacity of customs which are barbarous, and unwholesome in their operation, capacity for moral and intellectual progress of many mixed peoples, the possibility of a working relationship between the

advanced east and the advanced west, the applicability of European civilisation to Asia, and the solution of the great difficulties attending an unrestricted multiplication of the species—all face us in India, where for aught we know the Armageddon of the 20th century may be fought, or from whose decaying altars may be brought the fire to kindle conflagrations in other lands. "Out of the East light"—possibly in the shape of lightning, to discern the depths over which, and the rocks among which, the modern spirit is drifting. All things are yet possible in this strange land. Any birth is conceivable from the spiritual marriage between the Anglo-Saxon and the Hindu, which is now being consummated. Their strife has brought out the best and worst in both natures; their union may do the same. They must profoundly modify each other, but the extent to which their mutual influence will operate, or the miracles it will work, defy prediction.

Between India and Australia there must soon be special links and associations. Their irrigation systems will be of perennial interest to all hydraulic engineers, and especially to those on this side of the line. Our southern colonies are certain to be always in favour with their officials on furlough in search of health, or those who have retired, and seek a home in a temperate climate, free from the tropic heat of their field of labour, or the snows of their place of birth. Australians and Anglo-Indians are therefore bound to be acquaintances. Intimacy between the two countries will doubtless be established in course of time. They are part of one empire, and thus linked to one destiny.

Those relations which are likely to develop earliest, and be of most immediate importance, may be grouped under two heads—trade and invasion, peace and war. Both depend upon the maintenance of British supremacy in India, and the exclusion of any European rival. Under British domination free trade obtains, and the Indian ports are open to all our exports. Duties upon Indian products in Australia are mainly for revenue purposes, and in Victoria that upon tea has recently been swept away. There is no fiscal impediment therefore to a closer union of the two countries, and one would suppose, from the difference in age, climate, population, and economic conditions, that commercial intercourse would be likely to prove of mutual benefit. So far this does not appear to have been the case.

The future of Northern Australia is alleged to depend upon coloured agricultural labour, and if this be proved, it is certain that the cheapest relays could be obtained from Madras or Calcutta. The difficulty hitherto has been the stringency of the conditions imposed by the Indian Government, and its insistence upon the periodical return of its immigrants, in which respects it exactly complies with colonial requirements. If Asiatic labour is indispensable, the Hindu has his recommendations, especially if strictly limited in his absences from home, as indeed he invariably demands to be. If not the equal of the Chinese in enterprise or versatility, some of his tribes are their superiors in intellect and in war. The

general nature or final consequences of the pacific intercourse between the great peninsula and the newest of continents are too remote even for speculation, though the probability is that trade relations will draw us closer year by year, that trade being to the advantage of both parties, until, if not after, our tropical territories, and future island dependencies, are well developed.

In time of war the provisioning of troops might occasion a large and sudden demand for horses and supplies generally, though in such a crisis the thoughts of Australians are certain to be absorbed in the conflict and its issue, rather than in the commercial opportunities that may offer. The situation would certainly be very serious if it were possible for the Russians to occupy the country, and find at last another of those openings seawards for which their great Empire has so long been seeking. With India as a base of operations for a hostile power, this continent would be directly threatened, and though it may be doubted if we shall be strong enough, when the inevitable struggle comes, to lend any efficient aid in repelling a Muscovite attack, it would assuredly be immensely to our interest, not only as Britons, but as Australians, to see that assault repelled. It is probable that the first attack will fail, and certainly the country is to-day much better fitted to receive and sustain the shock than it was a few years ago. The frontier is better known and defined. The hill tribes are more friendly, railway communication is all but completed, and the army itself in finer fighting trim. There are, of course, as there always will be, reforms to be effected and preparations to be made, but it seems clear that there has been a great advance during the past decade, and that the Russians who have fought their way with splendid persistency to the heart of Asia, and whose troops are now exploring the Pamir table land to the north of Kashmir, in order to find a road southward, will find a warm welcome when they arrive.

This is not the place to descant upon military problems, and indeed it is quite unnecessary to attempt them after the exhaustive judgment upon the situation given by so eminent an authority as Sir Charles Dilke in his "Problems of Greater Britain." All present possibilities are there analysed with statesmanlike ability and special knowledge of the issues involved. But it is plain that the struggle is not far off. The motley crowd that throng the bazaars of Peshawur, and Lahore, contains groups who come from the Russian borders. Turkestan, or Independent Tartary, is disappearing from the map, and the rival white races will probably be face to face before long near the sources of the Amoor. The Hindus will probably be true to the British flag, and will resist anything but disaster. How they will face European troops when themselves led by Europeans remains to be seen, but in the first days of the Mutiny, before they were cowed, they certainly fought with desperate bravery. They are ill fitted to play a losing hazard, and are peculiarly subject to sudden panic, begotten by superstition as much as fear; but certain of their tribes are daring, resolute, and ferocious, and on these the main reliance must be placed. The pliancy,

fluidity, and patient persistency of the average Hindu, which enable him to resist innovation, and to assert himself, in a passive way, generation after generation, so as to keep him true, under all his obseqniousness and subserviency, to his national traits, beliefs, and customs, are not martial virtues, and are of no service in the field. The brunt of the battle will be borne by British regiments, inspired by traditions of the deeds of the Conquest and the Mutiny, which remain, and are likely to remain, among the heroic pages in the glorious chronicle of the race. We should not have known what innate capacity for daring, enduring, and governing, existed in the stock, if it had never struck root in India; and now that it has survived so many storms, and sealed its title with so much blood and treasure, the prize is not likely to be easily surrendered.

Carlyle says—"Consider now, if they asked us, Will you give up your Indian Empire or your Shakespeare, you English? Never have had any Indian Empire, or never have had any Shakespeare! Really, it were a grave question." And concludes:—"Indian Empire will go, at any rate, some day, but this Shakespeare does not go, he lasts for ever with us; we cannot give up our Shakespeare." Very true, though the "some day" which this rather despairing passage foresees has not yet arrived, and may be long arriving. Granting that, measuring odds and circumstances, it seems impossible for the Briton to keep his hold for another century upon this tropic empire, and its hordes of half-civilised peoples, it must still be remembered that it has always seemed equally impossible, and that its little garrison has surmounted crisis after crisis, and peril after peril. The miracle of valour and statecraft by which it has been subdued, may be repeated and prolonged by the same agencies—by new troops of resolute and gallant spirits sprung from the old race. It is, at all events, a critical issue for our young communities, which, in their pride of descent, and haughtiness of national feeling, seem apt to forget that they have made their homes neither in Europe nor America, but in Austral-Asia—Southern Asia—and that their fortunes may by this means be linked in the closest manner, in trade and in strife, in peace and in war, with the great continent near to us, whose richest and most magnificent promontory rests to-day under the shadow of the same flag.

It is infinitely pleasanter, no doubt, to ignore future possibilities of this kind, shut the eyes to signs and omens of the times, and preach peace where there is nowhere peace; but is it reasonable to pass by the great changes in locomotion by sea and land, which are bringing us nearer and nearer to the Old World, with its feuds and armed forces, its greed of territory and insatiable ambitions? In another quarter of a century the map of Asia, as well as of Europe, may be changed, and unless faced by a federated Australia, which, though democratic and pacific, would be prepared to resist aggression, and to maintain its flag, the belligerents may find our protecting stretch of ocean bridgeable, and our people unarmed or unorganised. To prepare for such a contingency is not to dread it, but is to render

it incapable of occasioning dread. It is not to question the naval supremacy of the mother country, or its readiness to come to our aid, but it is to recognise the responsibility of every virile people to protect itself, if it were only to maintain its self-respect. Such prospects, and such a policy, are not popular in the ordinary sense of the term. The average elector and his representative alike prefer to discuss matters nearer home, more local, more parochial, promising early profit, presenting means and ends more closely related, and in which there is a smaller element of chance, and narrower opening for prophecy. It seems better even to sport with the Amaryllis of Irrigation, and with the tangles of State socialism, rather than look so far ahead and travel so far afield. And yet such issues must have their place in our prevision, for in the event of the great catastrophe occurring, the local interests which we hold so dear, and the industrial democracy which it is our first aim to preserve, might perish in a common wreck. It is in the interests of home that we should look abroad, and in the interests of peace that we should be prepared for war.

It should count for something in our mental development that in this youngest part of the world we are actually within hail of the oldest portions, and that almost within the shadow of its most absolute military despotism our nation should be building up ultra democracies of the most pacific type. Cynics may profess to discern a likeness between them, or at least a kinship, but between what institutions or practices of humanity is there not some propinquity? What is there that exists which can give itself airs of exclusiveness, or proclaim its separateness from the universe of which it forms a part? That intellectual give and take which is everywhere a stimulus to thought should be especially quick and prolific between Australasia, or Southern Asia, and its northern continent. We are near enough to readily visit India and be visited. Its students might come to the universities of our milder climate, instead of facing the winters of Oxford, Paris, or Heidelberg. Our thinkers may yet become authorities upon questions which need personal acquaintance with India and its peoples.

It would be as idle to dwell upon forecasts of this order as it is foolish to discard them altogether. Until it be demonstrated that there is some reason why the nearest great country to us should be tabooed, its people, its products, and its destiny ignored, and all the flowing tides of its spiritual life and teaching excluded from those far-reaching currents which set to us past its shores, and influence men across the whole circumference of our planet, we may hold it to be inevitable, as well as natural, that one of the first outward going movements of our expansive Australian life will bring us into contact, and then into communion, with India. The fascination that it exercises upon our kindred will possibly be deepened for us, for the differences between our conditions and those of the East remain even greater than theirs. Until we cease to feel the pulse-beat of human thought, and to move in accordance with the mental and moral unfolding of the race, we cannot refuse

the attraction which the ancient wisdom of the Aryans exercises upon reflective persons; until we have ceased to feel the last faint touch of patriotism towards the islands in the Atlantic from which our fathers came, we cannot listen unthrilled and unfired to the story of the heroism by which this superb dominion was won, and has been held in defiance of all adverse fortunes; until the last spark of romance has faded from materialised breasts, given over to the gospel of greed and selfishness, we must be moved by the marvellous panorama which history has unrolled across the Himalayan snows, and along the valleys of their mighty rivers. Beethoven's march in the Ruins of Athens suggests in sound just such barbaric splendour, fiery impetuosity, martial pomp, and rhythmic sweep of tribal movement, as are displayed in this romantic tale of invasion, conquest and revolt, the stirring and recurring cadence, incoming and outgoing like a tide, echoing in the ear long after throb of drum and clang of cymbal have grandly and gradually died away.

"If I were to look over the whole world to find out the country most richly endowed with all the wealth, power, and beauty that nature can bestow—in some parts a very paradise on earth—I should point to India. If I were asked under what sky the human mind has most fully developed some of its choicest gifts, has most deeply pondered on the greatest problems of life, and has found solutions of some of them which well deserve the attention even of those who have studied Plato and Kant, I should point to India. And if I were to ask myself from what literature we, in Europe, we who have been nurtured almost exclusively on the thoughts of Greeks and Romans, and of one Semitic race, the Jewish, may draw that corrective which is most wanted, in order to make our inner life more perfect, more comprehensive, more universal, in fact, more truly human . . . . . again I should point to India."—MAX MULLER.

Though this glowing panegyric certainly needs qualification, it must be confessed that India is truly a land of wonders and wild extremes of the same surprising order as those depicted in the *Arabian Nights*—a country of contrasts and contradictions, of splendour and poverty, profusion and barrenness, vicissitude and adventure, voluptuousness and mortification of the flesh. The fires of a tropic sun kindle as well as wither, and the cup of life, recklessly filled to the brim of sensuous delectation, has been drained to its dregs of bitterness nowhere more deeply than in Hindu shades. Nowhere has the ascetic by protracted abstinences, ghastly penances, and frenzied self-mutilations, sought more ruthlessly to wring light and leading from his own suffering. Nowhere does the abundance of life in earth, air, and water, more amaze the sense and oppress the judgment; nowhere stagger millions of human beings under heavier burdens—some of the heaviest self-imposed. Nowhere is life more evidently the offspring and prophecy of death, for the land is marked with ruins as the sky with stars, and the very villages are built upon the sites of scores of others, melted to dust under the feet—fallen one

after another like beads upon the rosary of time. By the hoary and weary age of India now stands the eager youth of these southern lands, beholding, as if in a magic mirror, its rapidly-passing throng of peoples, kingdoms, dynastics, and creeds, that have succeeded, and are still succeeding each other, in an apparently endless chain. There is matter for meditation here. To-day Australia is full of hope, as Asia of despair. Racially, socially, politically, and industrially, far asunder as the poles, their geographical situation, bringing them face to face, may yet bring them hand to hand, and mind to mind. They have much to teach each other.

CHAPTER I.

THE BRITISH IN INDIA.

The story of Cortez in Mexico is more dramatically complete than that of Clive in Madras; the tale of Pizarro's ruthless robbery of the Incas more pitiful than the misinterpreted levy of Warren Hastings upon the Begums of Oudh; but undoubtedly the conquest of the Peninsula was originally accomplished in the same reckless and romantic manner, and sometimes by means as indefensible as were employed in America by the Spaniards. Without lingering upon its fascinating episodes let us glance at the present conditions under which the empire is maintained.

The traveller who anticipates that there are any outward and visible signs answering to the qualifying adjective "British," usually prefixed to the name of India, is wofully mistaken. There is nothing British in the aspect of the place, or its people; everything is Indian. The few white faces he sees now and then might be those of tourists like himself, and probably are. The cities, except in parts of a few capitals, the houses and streets, the residents, their garb, conveyances, habits, and language, the vegetation, the animal life, all are foreign to the English eye. The traveller has perhaps just left a P. and O. steamer, manned by Lascars, to find himself in a country in which his countrymen are far fewer in proportion to those they command than the white officers were on board ship. There are more Europeans in Egypt than in India, and as much evidence at present of British rule; that is to say, there are red-coated troops in its citadels, and English engineers upon its canals.

Those who wish to find the Saxon element in India must search for it. They will find it almost wholly beneath the surface. The population is as much an amalgam as the great image seen by the prophet Daniel in his vision, and the British is one of the least of its constituents. Our language is twenty-fourth on the list of spoken tongues. To say that the native races preponderate is not to sufficiently express their superiority in numbers, and the supremacy of their manner of life. India is Asiatic to the core, and all that is seen of it is Asiatic also. The British rule to a large extent by means of natives, and native organisations, or in the name and under cover of native authorities, and by native methods. Almost half India is still in courtesy treated as composed of independent states under native princes; but the evidences of English power are no more prominent in the Presidencies than in Hyderabad or Rajputana. The reign of law in the physical world is no more indicated to the casual glance of the unreflective than is the

British reign over India. Its white government is withdrawn for half the year into the distances of Olympian hills, and fulminates its decrees invisibly from among the clouds. In the cooler weather it apparently reveals itself only for purposes of pageantry.

As a matter of fact, the whole country is held in grip by a large army, which occupies all its strongholds and points of vantage, but is nowhere obtrusive of its presence. Order prevails in every province, and there is perfect safety for the unarmed throughout the length and breadth of the land. The one manifestation of British authority is the maintenance of just laws, and the firm suppression of all pillage and brigandage, except upon the part of guides, servants, and hotelkeepers. These may be regarded as licensed practitioners of the art on a peace footing, inheriting and cherishing the traditions of Timour, Nadir Shah, and a long succession of splendid robbers, whose practices are honoured daily by a most flattering fidelity of imitation. This assists in maintaining the local colour, which indeed is nowhere even modified by the white *régime*. India is Indian in every aspect, and European in hardly any. It has no tincture of western morals, or manners, outside the suburbs of one or two seaports and cities of official importance. It lives as only the East lives, glows as only the East glows, especially smells as only the East smells ; and remains to-day just as it was when first entered by Alexander, neither a civilised nor an Europeanised country, but "the cradle of the world and garden of the sun."

The conquest of this empire has been not inappropriately described as a miracle. Its retention is quite as marvellous. Both have been accomplished by means which seem so inadequate as to suggest some such supernatural guidance as the Hindus are always inclined to infer. The whites of India, all told, are as 1 to 2,000 of what may be termed the indigenous races. Deduct the soldiery—who are massed in certain garrisons and make little show outside the barracks—and there are nearly 4,000 dark-skinned residents for every Anglo-Saxon man, woman, or child. Even this figure does not convey the small degree to which Britons can be detected over the immense territory under their command. They are most of them concentrated in a few centres, and consequently there are large tracts in which one may pass days, among prosperous towns and innumerable busy villages, without meeting a compatriot. Even on the railways you may travel hundreds of miles without seeing a European, and in the country for days without hearing the English tongue. Enter a bank, a post-office, a Government department, or a great factory, and you will find but one or two whites, if any, surrounded by hundreds of Hindus. There are virtually no artisans or shopkeepers' employés but natives. Where an Englishman is employed it is as foreman or superintendent, and the number of these tends to diminish. On some railways native engine-drivers are continually being introduced : there are native magistrates, barristers, clergymen, contractors, bankers, and doctors everywhere ; there are many more Asiatic soldiers in the British Indian army than there are Britons, and the same people constitute

the great majority in the local bodies. In the whole country there are less than a thousand Europeans in trade, less than a thousand engaged in planting, less than a thousand who are professional men. There are many districts 1,200 or 1,500 square miles in extent, which contain but two or three Caucasians, and some of these are only present periodically during the year. It is no wonder, then, that such a pitiful minority should be almost lost to sight amidst the scores of millions of alien races among whom they reside.

The residence of Englishmen in India is always intermittent, and always for a period only. All who can afford it spend their summer among the hills; almost all leave the country on long furlough every few years; none make their homes there, none settle, none marry with the women of the country. Every year comes a fresh influx of the young, hopeful, and healthy, and every year an equal number depart to end their days under a less withering sky. The ferocity of the climate conquers even the national customs of the Saxon, alters his food, his dress, his house, his habits, and his ideas. He either forswears many meats and drinks of the mother country, or pays heavy penalties until he does; protects himself with pith helmets and umbrellas, or is struck down in the heat: and dwells not in brick or stone, but in plastered halls of great height, without hangings, little furniture, and less decoration, in which every old world comfort is ruthlessly sacrificed, or replaced by others of an entirely foreign cast. He changes his hours of rising and sleeping, of eating and of exercise, his self-helpfulness and his social relations; he is probably separated from his infant children, and often from his wife, for years.

The sacrifice made in order to live is perhaps repaid in many individual cases by the achievement of brilliant successes which would have been impossible elsewhere. The pale, wasted women of the south may have lightened the burden of their husbands, even at the sacrifice of health and motherly joys. The tide of youth, ability, and courage, poured out every year upon these burning sands, too often to sink out of sight among them, has already reared many superb memorials to the masterfulness and might of the race. Yet life in Southern Asia is exile, and is only endured at best. It is but natural that at times Anglo-Indians should look back upon their choice with bitterness, echoing the cry of their poet—

> What lured him to life in the tropic!
> Did he venture for fame or for pelf?
> Did he seek a career philanthropic?
> Or simply to better himself?
> But whate'er the temptation that brought him,
> Whether piety, dulness, or debts,
> He is here for a price, thou has bought him,
> O Land of Regrets.

The price of success in the peninsula is paid not simply in life but in opinion. Perhaps the greatest of all the transformations that may be noted in the Briton, who becomes an Anglo-Indian, is the change in his political ideals and principles. The disciple of

Bastiat maintains import duties with a protective incidence until Manchester interests prove too strong, and still retains export duties on food products. The student of Herbert Spencer becomes an advocate of State railways and irrigation canals, and exhibits no repugnance to the creation of profitable monopolies. The supporter of Mr. Gladstone refuses the suffrage not only to all natives but to his own countrymen, and openly depreciates representative institutions. The cardinal doctrine of the *laissez faire* school, that legislation is to be determined according to one set of dogmas in all times and under all conceivable circumstances, is infringed in every direction. Those who attack Irish Land Acts in the west, when they come to the east defend with zeal the traditions which make the State the sole landlord. In short the Government in Calcutta does daily and cheerfully all that it is forbidden to do in London, and does avowedly in the interest of the native races just what the parent Government is prevented from doing in the interests of white labour.

There are other contrasts equally suggestive. India is governed wholly from without, and there is practically nothing that even savours of self-government within its borders. What municipal institutions there are have little influence, and are not yet out of their teens. With the exception of a few picked men who have places in the Legislative Councils of the Presidencies, no native has any voice in any part of the government of his country. The white settlers are in precisely the same position. White and native alike are mere ciphers, or exercise only such illicit influence as is permitted to women in England and Australia. Power rests in the first instance with the Secretary of State, who acts chiefly upon the representations made to him by his officers in India, and a council of retired Anglo-Indians in London. His task is to decide in consultation with the English Cabinet upon the broad principles of policy to be followed, and to obtain their sanction either expressly or by implication from the House of Commons. That body devotes but a limited portion of its time to Indian questions, and contains but few men who understand them.

The real ruler of India is the Viceroy, who, if a strong man, like Clive, Hastings, Wellesley, Dalhousie, or Dufferin, can exercise an authority unknown in England or to Englishmen, greater than that of the Queen, and, within the law, not far short of that of the Czar. He has the advice of a council consisting of departmental heads to guide him if he chooses to accept it, but is in no way dependent upon its approval. He remains but for a few years, but, while the British Parliament allows him to reign, he is supreme. Madras, Bombay, the North-west provinces, and Bengal are ruled by Governors or Lieutenant-Governors, who are advised by councils, but they are subject in all important matters to their chief in Calcutta, who appoints to the latter offices. The two first Presidencies are filled by men from England, chosen for party reasons. The Panjab has a Lieutenant-Governor but no council, and Burmah has but a rudimentary administration as yet. Among

Indian officials seniority counts for something, though merit occasionally forces its way upward without it, but the "seniority and merit combined" which count for so much in our own public service, are not omnipotent there. Tho Government is personal—a despotism tempered only by resolutions from the House of Commons. Personal influences accomplish a great deal in all departments. Public opinion, always weak in India, especially if against Cæsar, is the only check upon its exercise. It is a check of the feeblest. The Government is anti-democratic in every respect; it is an exotic, it is nomadic, always external to the country, always personal, and capable of unlimited abuse.

The actual administration seems much better than its constitution would lead the critic to expect. The exercise of favouritism is said to be on the whole decreasing, and now and then conspicuous capacity receives its meed by this means. The service, whatever its faults, is unquestionably able and incorruptible, answering with unswerving loyalty to the demands of its chiefs. The Central Government in particular, and those of the Presidencies scarcely less, are actuated by excellent motives. The balance between native and white is not only held level, but there is an open leaning to the coloured side on many issues. There has been very high-handed and contestable treatment of independent States in past times, but for a long time an anxious and even painful solicitude to do them justice has been manifested at headquarters. The welfare of subject races has been the aim in recent years of much careful legislation, of enormous expenditure, and of indefatigable activity on the part of the autocratic rulers, and of those who execute their behests. Canal engineers complain that they are not supported when treating for land with villagers, or in their efforts to protect their works from trespassers, and that unfair royalties are levied upon them for the benefit of native states. So tender is the solicitude of those at the head of affairs, for ryot and rajah, that the irrigation enterprise is weighted with payments and privileges, rather than there should be any doubt of the justice of the Government. The aim of the State is to do for the Hindu what he will not or cannot do for himself, and its *régime* is therefore in every sense of the term paternal. It even spares the rod to such an extent as to run the risk of spoiling its step-child. The net result is a benevolent tyranny, leaning a little towards unnecessary officiousness. The tyrant has not been content to offer what he believed to be advantages, but sometimes has gone so far as to thrust them upon his subjects. This, however, was rare, and is becoming rarer. The Government is now convinced that India can never be British in its conditions, and will never be British except in rule and principle. It has to be accepted as Asiatic, and governed on Asiatic lines. We found a despotism, and we preserve it, striving not to alter or weaken it, but to make it sympathetic and just.

Hampered to some extent by its oversea responsibilities, the Government remains martial, not merely because of the necessity of dominating the peninsula, but in order to protect it against ex-

ternal aggression. The increase in its revenues during the years 1885-86 to 1888-89 amounted altogether to £7,000,000, and yet the expenditure kept pace with it to such an extent that the last year only showed a surplus of £37,000. From 1887-88 to 1890-91 the net revenue, excluding opium, salt, and provincial rates, advanced by £1,260,000, but in the same time the increase of the military budget alone swallowed up a larger sum. It is true that the security afforded is as much to the Hindu taxpayers as to the white officials. It is true that the peace enjoyed throughout the whole country, and which could not be enjoyed without a white supremacy, is worth more than is paid for it; but the burden remains to prevent the more liberal treatment of proposals for fresh canals. A military Government is never the most sympathetic, and where that Government is composed of men of another race, speaking another tongue, and shaped by another civilisation, it is not to be expected that it should look too sympathetically upon the foibles of the dark-skinned races over whom it reigns. The study of native literature, languages, and customs has done much of late to qualify the civil servant for his task, but without personal interest in his work, and feeling for the helpless thousands committed to his charge, these cannot go far. The wonder is that they go so far.

Bureaucracy was defined by Balzac as "a gigantic power set in motion by dwarfs," creating "a power of inertia" in the "Report" of officials, of whom he says, "No one comes or stays in the Government offices but idlers, incapables, or fools." Bureaucracy is as paramount in India as in France or Russia; the "Report" reigns without a rival, and the inevitable evils of administration by documents therefore appear on every hand. Red-tape is king, and Sealing-wax is high priest. But the members of the public service are by no means the despicable creatures painted by the French novelist, or more lightly satirised by Dickens. They are, as a rule, picked men, clever, well-trained, conscientious, and energetic. Their defects appear to be rather in sympathy than in spirit, and in manners more than in character. The nature of their surroundings, their privileged position, and their Asiatic *clientèle*, combine very naturally to develop the self-conceit, class feeling, and hauteur of some of those occupying subordinate posts. The chiefs are almost invariably men of tact and politeness, but those who serve under them are, or imagine themselves, among whites, what Brahmans are among Hindus; they have the consciousness of being "twice born," of wearing an invisible "sacred thread," and of looking down from a lofty height upon the resident or stranger who is not of their caste. Hence the story of the child of an official who, bearing in mind the parental attitude towards them, asked its mother if "uncovenanted" civil servants could ever attain salvation. There is an absurd order of precedence which puts the "griffin," or as we should say "new chum," who arrived yesterday to take his stool in a Government department, before the professional men of eminence, or merchants of standing who have grown grey in the

country. Officialdom is nowhere more rampant than in India, but at the same time it must be confessed that nowhere is it abler, more upright, or more polite to the visitor.

Private enterprise scarcely exists in India. There is a prosperous commerce, and there are certain speculative investments such as mining and planting, which are in European hands, but the total of these is inconsiderable, and their sphere strictly limited. The production and business of the country as a whole are in native hands, and are carried on in native fashion. The great public works have been executed by Government, or are rapidly passing into its control. There was an epoch when the advantages of encouraging the investment of British capital in India were officially recognised, and when steps were taken to invite it. The State went so far as to guarantee a certain interest upon sums expended in approved enterprises. Many of the greatest railways in the country were constructed on this plan. The same desire for the introduction of European activity still exists, but there is a change of opinion as to the method to be adopted. It is found that when the State gives a guarantee it constitutes itself a partner in an undertaking of which it has to bear all the risks without receiving a fair share of the profits. The same principle has been applied to irrigation works, and with no better success. Consequently the capital and the business, as well as the authority of the country, are, after the Oriental fashion, in the Government itself.

The problems involved in railway construction and management are most of them peculiar to the country, and demand no lengthy criticism in this connection. There are nearly 5,000 miles built and owned by the State, nearly 7,000 miles built by the State and worked by private companies, upwards of 3,000 miles built and worked by guaranteed companies and 200 miles by assisted companies, besides over 1,000 miles in native states. The capital invested is upwards of £200,000,000, yielding with subsidiary steamboat services a net return of 5 per cent. It suffices to say that the accommodation afforded to white passengers is, on the whole, admirable, and the value of the lines commercially, or from a military point of view, inestimable.

The direct interferences of the House of Commons of late years have been, as befits so great a Chamber, few but important. The abolition of the duties which gave a slight protection to the cotton-mills of Bombay was accomplished in India itself by Lord Lytton, to some extent under the influence of Manchester merchants, who remarked the growth of the local competitor with undisguised alarm. Doubtless the Viceroy believed that he was acting in the interest of the country over which he ruled, but assuredly the English importer who encouraged him was actuated solely by trade selfishness. The blow was felt by the new industry, but the disparity in wages remained so great between the two countries that it sustained the shock, and adapted itself to its new circumstances. Fine fabrics and patterned goods, formerly made by hand in the country, are imported from England in immense quantities,

but the common and coarser materials are manufactured by steam machinery in India, and are steadily gaining a market there, in China, and in the further east. The great mills, which are the real rivals of Manchester, are a good property, paying their owners from 15 per cent. to 20 per cent. upon their capital; have white foremen at high wages, and hosts of native workpeople.

The British manufacturer has once more taken alarm at their progress, and has called attention to the long hours of labour, employment of women, age of children, and sanitary condition of Indian mills. His interested motive may be partly excused in the excellence of the reform achieved. A commission was accordingly appointed in India, which has taken much evidence, and recommended legislation of a moderate character, to regulate hours, and holidays, and provide for women and children. It is safe to say that this will not prevent the growth of local industries of this description, and at the same time that it will not come a day too soon. The mills visited by me were at Ahmedabad, employing 1,500 persons, the women at 12s. a month, and the males, from boys at 8s., to adults at 20s., a month. They contained 600 looms, and 43,000 spindles, kept in full work by camel loads of cotton brought direct from the growers. The hours worked were from 12 in winter to 13 or 14 in summer. The cheapness of production under such conditions is in some degree balanced by the circumstance that an English mill-hand does the work of at least four natives. They suggested as much by their demeanour, standing before their looms, all but naked, like so many cattle, cheery and chattering, fairly attentive, but rather careless and stupid—a class of human animals who are yet likely to play a part in the fortunes of that section of the world which always buys in the cheapest markets. Similar factories are being erected in China. Other trades will follow. The manufacturers of the future will require to take Asia into account.

A House of Commons resolution condemned the liquor legislation of the Indian Empire two years ago, provoking an elaborate rejoinder from the Government, which discounted most of the statements upon which Parliament was moved. It is, nevertheless, admitted that the restrictions of the Muhammadan law, and of certain castes, have been of the highest value to the Hindus, who like all other races with whom the whites are brought in contact, appear to suffer severely if permitted the free use of our familiar forms of alcohol. The import duties on spirits have been increased, and taxation imposed on malt liquors brewed in the country. In Bengal the outstill system has been abolished, and in the Madras Presidency 7,000 liquor shops were closed in 1889-90, but the risk of permitting the traffic to develop as it has done of late years is indisputable, and the number of drinking houses in Calcutta and Bombay tells its own tale. There should be no difficulty in suppressing them, with gain to the community and ultimate gain to the revenue as well.

The Commons resolution condemnatory of the opium traffic has the same moral arguments in its favour, though the consequences

of indulgence fall upon another people. "It is historically false, although frequently asserted," says Sir John Strachey, "that we have made war with China with the object of forcing our opium upon her against her will," and he emphatically declares that in this respect Great Britain has no responsibility. He quotes the statements of Chinese Ministers made in 1881 to Sir Thomas Wade, to the effect that the "habit was too confirmed to be stopped by official intervention," and that "opium will be procured either from India or elsewhere." The growth of opium in Western China is steadily increasing, and a good deal of the Celestial zeal against Indian imports may be suspected to be promoted in the interests of the local producer. Nevertheless, it is an abominable traffic to be carried on by Government sanction; and though the £8,000,000 a year profit which it yields to the Treasury comes out of Chinese pockets, and goes into the Indian exchequer, it is clear that the moral sense of the English will not permit a continuance of the trade. It may be noted in passing that the patriots of the Congress lent no support to the demand for the cessation of this most profitable monopoly, which very largely adds to the prosperity of the North-west provinces and the independent states of the same latitude.

The local English press maintains the reputation which belongs to the journals of the mother country and her colonies. It is partisan, of course, but is conducted with great ability. The majority of the newspapers are in sympathy with the Government. Those which assume the *rôle* of critics and lean to native views, exhibit less talent, but contain delicious passages of Hindu-English composition. There is nothing in any of them approaching the local news to which Anglo-Saxons are accustomed in their own countries. Of the vernacular organs the stranger is unable to speak.

What the British Government has accomplished in the way of irrigation cannot be appreciated, unless the enormous difficulties under which it has been accomplished are understood. How far the Government may be able to complete its projects for the material development of the country depends upon its future history, and this it would be bold even for a prophet to attempt to forecast. Strong and successful by reason of the ability and character of its masters, like all other Asiatic Governments, it exhibits a certain instability. This is increased in no ordinary degree by the fact that the white officials, who come by training to understand the needs of the country, are not free to shape its course according to local conditions. The Hindu races, castes, and States are subject to the active overrule of a people alien in blood, spirit, and purpose, living in another climate, in another continent, and practically in another age. It must always be difficult to maintain a despotism within a democracy; the methods and principles of the one are bound to conflict with those of the other. It may be assumed that the House of Commons will always contain a majority ignorant of Indian affairs, and viewing them, at 6,000 miles distance, under mistaken preconceptions. A similar difficulty presented itself at Rome under the

Republic, where the rule of Proconsuls proceeded upon very different lines to those adopted in the seven-hilled city and its environs. There has never been the same misgovernment of India as there was of Roman provinces, but there has been, and is still, a necessary subordination of the conquered country, and a suppression of its individuality, which, though abundantly beneficial to its inhabitants on the whole, renders their relations to Great Britain irksome, and affords a constant opportunity to those whose advantage lies in promoting misunderstanding. There is plenty of room for mistrust. The country has been won by the sword, and is held by the sword; its Government is imposed upon the people by force, and is administered by foreigners, upon a policy independent of their interests, far more enlightened than theirs, but nevertheless to them strange, uncomprehended, and unacceptable.

What would happen if the best Hindus were endowed with control of the treasury, or a place at the council table of the provincial governor, it is too early to inquire. The probabilities are that irrigation schemes would be pushed on, while the military budget would be cut down, and the incidence of taxation varied; but the contingency is not yet near enough to render its present consideration essential. The movement to secure a measure of representation for the natives is now in its seventh year, the sixth congress sitting during the time of my visit. Judging it by the men who took a leading part in its proceedings, it is influential and strong. It must be admitted by the most captious that the speeches made by its chiefs were worthy of being uttered from any platform in the mother country, or indeed, in the House of Commons itself. The English employed was not merely correct, but apt, and at times choice; the style was clear and strong, the logical construction complete, and the periods often eloquent. There was nothing except the names to tell the reader that the addresses proceeded from the mouths of men who were not of British blood. Whether or not they represent only a study of good models, and the repetition of borrowed ideas, as their antagonists maintain, it is quite certain that they attain more success than the equally studied and equally borrowed utterances of most public speakers. It would be hard to say that originality of manner and matter were to be required, in addition to oratorical power, as a qualification for the suffrage, without excluding most of the electors of the British Isles. Such a "counsel of perfection" could not be seriously upheld by practical men, and it is preposterous to maintain that the ability displayed at the congress is not of itself a sufficient evidence of fitness not only to create, but to compose a representative body.

The question raised, however, is not so simply solved. Because there are a handful of brilliant speakers, advocates by profession, who are capable of leading and inspiring gatherings of 1,000 or 2,000 men, selected out of a population of 286,000,000, it is not proved that there ought to be any sudden change in the Government of this dependent empire. The requests of the congress party are moderate, being limited to a plea for additions to the ex-

isting legislative councils, raising the provincial to bodies of between 36 to 48 members, and the central to from 40 to 60 members. There are already nominee natives in all the councils, but it is proposed that the new men should be elected, the constituency, according to Mr. Bradlaugh's last Bill, to be chosen by the Government, and not to include less than 2 per cent. of the adult males. How the line is to be drawn which shall shut out 98 per cent., what tests of fitness can be applied when it is character as well as intellect which needs to be weighed in the balance, and how election machinery can be adapted to the Oriental mind and manners, are problems which may well puzzle any Ministry in London.

The congress party confess their own inability to face such issues when they seek to impose them upon the very administration which they denounce as unsatisfactory. They realise the dangers arising from strongly-marked differences of race, creed, and principle among themselves, but, though these have endured for ages, trust somewhat irrationally to time, to speedily dispose of them. They seek by alterations in the courts, and the introduction of juries, to put greater judicial power into Hindu hands, ignoring the circumstance that the natives themselves prefer British advocates and judges whenever they can obtain them ; ask for reform of the police, which is only possible by reforming the morale of their own countrymen ; for native military colleges when it is becoming each year more difficult to fill the ranks of the native army with soldierly men ; for the right of natives to carry arms, which would in many cases be employed against each other ; for reductions of taxation, and increases of expenditure upon education and in other ways. None of the objects acknowledged by the congress are undesirable, and indeed all of them represent ideals towards which progress should be sought. The exclusion of Hindus and Muhammadans of ability from the legislative councils is a loss to both the natives and the British ; the public service needs to be brought into closer sympathy with the masses. The white non-official population of the country have a right to be heard in public affairs, and to be better recognised ; the judiciary and executive require to be severed ; the offensiveness of bureaucracy needs to be checked, and the support of the native peoples enlisted on the British side. It would be presumptuous for a mere tourist to pronounce upon the best means of attaining these ends, but the thoughtful Radical must admit, that election and representation are not necessarily the only, or best, means of securing them, among the half-savage races who go towards making up the Indian Empire.

Sir William Hunter, in his invaluable encyclopaediac work upon the Indian empire, enters at length into the question of the relative cost of the Mughal and British empires to the people of the country. What the Hindu got for his contribution under Aurungzeb was an unsatisfactory protection against foreign invasion, a very incomplete security against corrupt officialdom at home, little in the shape of public works, and very indifferent

police protection. What he obtains under Queen Victoria is a complete protection against foreign rapine or official pillage, except by men of his own race in the lower ranks of Government employ; a superb endowment of public works, which mitigate the severity of famines and multiply commercial opportunities, with a police protection which, bad as it admittedly is, is as good as the available European supervision can make it. A much smaller population than now pays £40,000,000 to Queen Victoria paid Aurungzeb £60,000,000 annually. The land-tax to the Mughal was £35,000,000, while to the Queen it is less than £20,000,000. As a matter of fact, the legal exactions under the old *régime* were much heavier in many provinces than those here cited; while of the illicit exactions there is neither record nor reliable estimate. although it is certain that they were very heavy. In point of fact, the Hindu then owned just what was left to him by his rulers. Akbar's maxim was: "There shall be left for every man who cultivates his lands as much as he requires for his own support till the next crop be reached, and that of his family, and for seed. This much shall be left to him; what remains is land-tax, and shall go to the public treasury." On its way to the treasury it probably paid toll several times; the assessor required his fee, the collector his, and the local potentate his. There were 40 other imposts besides that upon land, including a poll-tax for all who were not Muhammedans. Measured by rupees, therefore, the Hindu is immeasurably the gainer by the change, and measured by his protection from famine, or invasion, and the multiplication of commercial opportunities, he is still more advantaged. Yet the North-west province, in which the Mughal emperor held his court, was the heart of the great mutiny of 1857, and might be so again. To the average Hindu there was no history, there are no principles of political freedom, no guarantee for any Government except that of the strongest.

Finally, then, the British Government of India is a compound of contradictions, for, while practically absolute in authority and vested in two or three men entirely, it is supposed by many to be controlled by a popular assembly; military in spirit, it is bureaucratic in method, and pacific in end; conservative in practice, it adopts many radical principles; and, committed wholly at first. and often still, to the energy, judgment, and initiative of individuals, has created for them a complete system of written regulations embracing the whole field of possible activity. No public service is so enslaved by the pen, and yet even the civil members of it may be said to live in the shadow of the sword. Separated by immense distances which forbid frequent personal association, all business is conducted by correspondence; the affairs of the country, from the most momentous foreign relations to the pettiest details, being set out upon papers which are passed from hand to hand. It is a Government of minutes based upon memos. Even its soldiers command in the attitude in which Boehm has placed the great governor of the Panjab in his bronze statue at Lahore, sword in one

hand and quill in the other. It would be hard indeed to say which has now the mightiest influence on its administration. While the soldier, like Henry Lawrence, has often done the most distinguished work in times of peace, the civilian, like John Lawrence, has come forward as a warrior in the hour of need to save an empire tottering under a stab in the back from the treacherous hand of mutiny.

British India, in short, is British neither in race, religion, language, policy, sentiment, nor aspiration. Garrisoned by a few Britons, and governed by still fewer, it not only retains its Asiatic complexion, but impresses its character to a large extent upon its conquerors. The British in India have themselves ceased to be British in many respects. They have developed castes and curious creeds, walk with troops of retainers, live like Persian satraps or Roman proconsuls, coming at last to think and speak in the phrase of the Orient, and with its vivid colouring. It is they who have adapted themselves to the Hindu, and not the Hindu who has taken their imprint. It was not to strengthen her hold upon her British subjects that the time-honoured title of the Queen was altered to that of Empress of India. Bearing in mind how few are the whites in proportion to the hordes of varied hue who swarm from Cape Comorin to the Himalayas, and the extent to which they have required to stoop to the conditions of life in the tropics in order to conquer, it is not too much to say that the first fact requiring to be fixed in the mind of the inquirer is, that India to-day is altogether Asiatic in the spirit and form of its life and institutions, and British only in flag, in fame, and in name.

CHAPTER II.

THE NATIVE POPULATION.

The importance, and indeed the all-importance, in any study of Indian affairs, of an accurate knowledge of the native population, has been already suggested in the preceding chapter. It has been incidentally indicated, at the same time, how many stocks are more or less imperfectly blended among its enormous masses.

It is true that there is a certain apparent unity in the life of the inhabitants occasioned by the sameness of the dress assumed by British administration; its far-stretching railways; its ubiquitous officialdom; its tens of thousands of white soldiery; its common currency and all-embracing law; but the surface only is affected. and beneath this semblance of universal likeness the original differences between race and race, caste and caste, creed and creed, or district and district, remain chief factors of the situation. What may be true of one or some of these is not true of others. The peoples are conservative of their varying characteristics, and carefully maintain many of them. Each province presents its immemorial observances, its ancient forms of belief and ways of life. and its sacred traditional practices. The consequence is a condition of things difficult for the stranger to conceive. He finds in this one territory "all the oldest religions, all the oldest customs, petrified: no form of popular government yet possible. Everything which Europe, and still more the New World, has outlived, still flourishing in full vigour; superstition, fatalism, polygamy, the most primitive priestcraft, the most primitive despotism." There is manifestly little unity to be anticipated amongst such inheritances as these.

The very fact of the British possession of India testifies to the native diversities. It is hard to see what natural tie could blend such peoples and their Anglo-Saxon rulers since. as Professor Seeley says, there is between them neither community of blood, nor community of religion, nor community of interest—except so much as there must be between all trading countries. In a sense these ties are also wanting between the various sections of the coloured population, and, indeed, it is due to the radical differences between them that the British control was established and is maintained. The bulk of the inhabitants have for centuries obeyed alien masters. and are less embittered against the white invader than against some of their neighbours who are now subject to the same authority. Almost every native state has fallen by the swords of native soldiers. though of course these were taught and officered by Englishmen, and

supported by comparatively small bodies of English troops. Neither the conquest, nor the mutiny, nor the reign of peace since has as yet created any other unity in "India" than that of British rule.

If they are regarded attentively three distinct groups of races can be distinguished, although the great bulk of the population now consists of a mixed people, composed of a blending of the three. The first group is that of the original non-Aryan inhabitants, mainly found as scattered tribes in outlying and inaccessible retreats. They are by no means of one status or language. Some of these are still, and many were until recently, in a condition of barbarism not much superior to that of the Australian aborigines. But the tribes of the forest and hill are of a higher type, make spirited soldiers, and exhibit fine martial virtues. All of these are believed to have reached India from the north-east, but the greatest people of this group, the Dravidas, came from the north-west, preceding the invasion of the Aryans from the same quarter, and maintaining friendly relations with them when they did come. Southern India is to-day peopled by 20,000,000 Dravidas, speaking Dravidian tongues, and possessing a literature and architecture of high merit. They have been Brahmanised in religion to a great extent, as have most of the earlier non-Aryan group, but in their turn have greatly influenced the development of ancient Vedism into modern Hinduism. The next group of races comprises the lighter-coloured Turks, Afghans, and Mughals, who entered the country after the Aryans as Muhammadan invaders. By their energy and courage they retained political mastery of the north and east of the peninsula for several centuries. The Aryans who entered the Panjab between the influx of these two groups were a people of a higher rank. As the inheritors of the Sanscrit language and literature, and as poets, metaphysicians, mathematicians, or statesmen, they have been, and are, the intellectual leaders of the peoples of India. They are chiefly represented by the Brahman caste, which has imposed its authority in the most absolute manner upon all but the Islamites, and out of the very various materials within reach has created by compromise the complex Hindu religion of the present day, and the social organisation belonging to it. The Aryans and Muhammadans, though small minorities, have always been, and still remain, the mainspring of the intellectual and political life of the peninsula; they are the descendants of its most masterful Asiatic invaders, the inheritors of the Vedas and the Koran.

It is unnecessary to trace these distinctions further. Strictly speaking, only a proportion of the 286,000,000 people of India belong to the blend of races known as Hindu; but they are the greater proportion, and the name is convenient for referring to the whole body of the dark-skinned residents. It is true that they are divided into innumerable castes and sects among themselves, but all their differences, though great, are minor beside the broad contrast between the whole of them and their European masters. Taking the native races in the gross in this relation, they exhibit certain general characteristics, which can be predicated without

serious inaccuracy of the Hindus as a people. They are British subjects, citizens of the same empire as ourselves, and are already allied to us by commercial ties which should strengthen and multiply as years roll on. It is necessary in our own interest that we should seek to understand them, and it will be impossible to convey a clear idea of the irrigation of India unless the nature of its people is allowed for. The whole of the State's customers upon its great irrigation schemes are Hindus, and hence Hindu methods and Hindu characteristics confront the enquirer at every turn. These must be noted to some extent, no matter how rudimentary and imperfect the sketch may be.

In every country there is a minority which enjoys more of the good things of life, more opportunities of culture, more leisure, power, and influence than the majority. This minority in India is remarkable for its smallness. It is but a fraction of the whole. The country has produced many great statesmen, warriors, poets, and philosophers in the past, and possesses a certain number of able, high-minded, and well-educated Hindus, holding high and responsible positions to-day, but such men are far less numerous than they would be among an European people, and the gulf between them and the masses of their countrymen is greater. They are units out of millions. Rajahs, who are worthy of their position, professional men who compete with whites in their own field, or men of taste and learning, who add a western breadth of enlightenment to Oriental depth and intensity, may be left out of the question for the present. It is not of these, but of the millions, that one can generalise. Further, in glancing at them and at their modes of life, it is necessary to abandon all preconceptions and associations bred from European experience, and to realise that everything in India, from the ground upwards, is essentially foreign in its character and appearance, although described by familiar words.

To begin with, the towns, which have in some few instances public buildings of great magnificence such as it is impossible not to note, there is, after all, a great monotony in the appearance of their private quarters, and after the first few have been well scanned there are no surprises for the traveller. To be transported in an instant, as in an *Arabian Nights* story, into the bye-lanes or blind alleys of any one of them, would be utterly confusing to any tourist. There are characteristic features, it is true, especially in the chief places and great structures, when there are any. Ahmedabad, Ajmere, Allahabad, Patna, or Poona, though not so famous or unique as the great capitals, have distinguishing traits of their own, which are readily discernible. Their situations differ, their people differ, and their customs differ. But their back streets and buildings do not so noticeably contrast as would enable even an Anglo-Indian to say which it was that he had been supernaturally wafted to. There are divergences between the Tamil towns, and those of the Marathas or Rajputs, but these are not great: the type is essentially the same, and to have seen one native city thoroughly, so far as their modern native quarters are concerned, is practically to

have seen them all. The type displays a network of narrow and crooked lanes without footpaths, bordered by square, flat-roofed sparsely-windowed houses, and their tiny courts filled with nude children and lean animals, the whole having an air of untidiness, squalor, and discomfort. As for the villages in the same tract, they are entirely indistinguishable, and, indeed, throughout the whole empire are built upon exactly the same model, with the thatched one or two roomed adobe hut for its almost invariable unit. The materials vary, and the style of structure in minor particulars, as the people do in their dress, in their tints, and in their cast of countenance, but this does not alter the fact that all are brown, more or less nude, of allied and intermingled race, living in the same class of houses, and in towns whose swarming tenements and dirty ways bear a striking resemblance in all the Presidencies.

Something may be learned by looking at the people and marking what their exterior tells of disposition and capacity; but at the outset, it must be remembered that half of one sex is invisible. Only women of the lower castes, except those who belong to a separate people like the Parsis, are ever to be seen. Whether Brahmanists or Muhammadans, they live under lock and key, and are not permitted beyond the seclusion of the Zenana unless in disguise. When they venture abroad, and this is rarely, they do so under almost as many restrictions as lepers. Those who are compelled to go on foot appear under a long white extinguisher, which hides the face, form, dress, age, and all but the height of the wearer. Two small latticed apertures allow them to look out upon the street sufficiently to pick their way, and that is all. Women of the better class are driven in little bullock-gigs, with tent coverings, in which there are but two small slits. These require to be opened before they can be looked through by the occupant, and thus the tips of their fingers alone appear in the daylight. We happened, in one native state, to meet a rajah about to travel with his wife. She had been brought to the station in his closed carriage, transferred to the waiting-room by a private way, and carried thence to the train in a curtained palanquin, the side of which was placed against the door of a compartment, with its blinds drawn. A large piece of drapery was then held up from one to the other, so as to cover her exit and entrance, without the possibility of even the attendants beholding her. This feat was finally accomplished with as much elaborate caution as if a dangerous wild beast had been transferred from cage to cage. Yet this noble spoke as a man of the world, and paid an English governess a high salary to give a western education to the spouse whom he shrouded from every eye with such Oriental precaution. Under conditions like these it is evident that the opinions expressed must relate only to those women who can be seen, and with the exception of Parsis, these all belong to the poorest classes.

There is an infinite variety in the complexion, physique, and garb of the Hindus. The first glimpse of the country afforded to the voyager from Ceylon discloses the pagoda of Trichindore, standing

up from the shore upon a rocky height, dominating the landscape as the faith of which it is a shrine dominates the life and habits of the whole south. The first of its sons to approach are Tamils, who come out in their cargo boats to the ships, lying four miles off the dangerous and surf-beaten shore. Dark-skinned, and with but a handkerchief costume, these picked men have the muscle and pose of athletes. Unloading a vessel in their own fashion they offer a subject full of vigour and character which might have delighted Michael Angelo. Southerners, as a rule, especially the males, have supple figures, and keep them well on view. Towards Central India both sexes are smaller, though with an air of greater energy. In the Panjab men are taller, more sinewy, and more dashing in their style. The black-bearded Sikhs have a warrior's stride; the Afghan's Jewish caste of countenance supports the popular theory of his origin, while the Central Asian, and those from the north-western frontier, exhibit rude and savage traits, and if from the north-east a Mongolian cast of countenance. In the west, the skin has usually a sunburned tint, and peasants are often all but black. Many Muhammadans are of yellow tinge, the fat and sleek Bengali baboo is somewhat darker, while the high caste Brahmans are usually of a light red brown. All Muhammadans, and no Hindu civilians, wear whiskers; a moustache is common to both. The head is often tonsured, shaving as well as tooth-cleaning being a religious duty in all castes.

Children are almost invariably pretty in all parts. Among the adults there is naturally a great diversity of feature, though not more than may be noted in any miscellaneous Anglo-Saxon gathering—good figures are not uncommon and good faces not rare. The soul of Socrates glowed behind the face of a Silenus, and it is of course possible that the straight nose, high arched forehead, well shaped head, and poetic lips of the best Hindus may sometimes conceal a character as infamous as that of Nana Sahib. It is, at all events, something in their favour that a fair number even of the poorer classes have a distinctly well-bred air and pleasant countenances. Barefooted and untrammelled by clothing, their gait is far freer and finer than that of Europeans, while the carriage of the women, extremely graceful, owing to the universal practice of balancing water ewers upon the head, would put to shame the lady pedestrians of civilised lands.

Dress is largely a matter of climate and season everywhere, and its chief varieties in India are due to the same causes. There is little anywhere on which a distinction between underclothing and outerclothing could be made. The working attire of males in warm weather represents the irreducible minimum of decency, though, such as it is, the rag is always rigorously preserved. The girdle of the man becomes a girdle cloth with the woman. In parts of the south it may be said of both sexes that they wear but little here below, nor wear that little long. In addition, the lady always possesses within reach a piece of cotton drapery, which serves as head-dress, veil, cloak, and skirt, in turn or all at once. Further

north the Hindu women adopt the petticoat, while their Sikh and Muhammadan sisters appear in what, according to Dean Stanley, is the only ecclesiastical vestment recognised by the early fathers—that is, trousers. These are of cotton, made tight below the knee and loose above, just like those of the men in these regions. Upper garments become more plentiful towards the Himalayas. Cashmerian or Sikh peasants are warmly clad and thickly turbaned, while horse-dealers from Afghanistan add as an overall a rough undressed sheep-skin coat. Children up to three or five years old are often perfectly nude, and sometimes boys of nearly twice that age, but nowhere is there any intentional indecency on the part of man or woman. Hats and boots are unknown, many of the poor going always bareheaded. Caps and turbans are the general covering, the latter assuming many shapes and hues. Slippers are generally worn in the north and in Calcutta, but stockings are very rare, although silver-plated toes and ankles are not. Gloves are undreamt of, even by the dandies—for there are dandies of all degrees of tawdriness, exhibiting just the same harmless littleness as if they walked Collins Street, Melbourne, or Pitt Street, Sydney, every day. It is doubtful if there is a handkerchief to be found in the hands of an unofficial native between Peshawur and Cape Comorin.

The clothing of the Central Asian is intended to be warm, and dirt is generally an appreciable element in its thickness, but on the whole the dress of the peoples of India is not only decorous according to their lights, but fairly clean considering their surroundings. Many rejoice in spotless white linen, and the rich are gorgeous on State occasions in velvets and plushes, while gold and silver embroideries wander over their attire from their slippers to their turbans. Rajahs and nobles are often loaded with jewels. Parsi ladies appear in loose trousers, or in ample flowing robes of extremely gay hue, and their male relatives indulge in such remarkable combinations as salmon-coloured vests, with blue silk breeches. King Solomon in all his glory was not arrayed like one of these; while for a parallel to the brightness and variety of dress among a bevy of Parsi women, one must turn to the old Scriptural prints in which the apostles appeared like a troop of Josephs, in robes, whose many and violently contrasted colours, evinced a profound indifference to the æsthetic harmonies, and neutral tints, of which the moderns are enamoured. A taste for decided effects in costume discovers itself in all races and in all classes—bright red skirts and blue upper garments, or a purple turban, a yellow jacket, white waistcloth, and green smalls being sometimes united in one dazzling whole. The result is naturally extremely striking; decided colours harmonise well with dark skins, and are always charming in the mass.

Woman has been cynically defined as "an animal that loves finery," and so far as the definition is true, it is true of the sex. White women themselves are not more devoted to personal decoration than brown. Certainly, except the lady who makes "music wherever she goes," there can have been none more addicted to

jewellery. The Hindu woman, whether princess or peasant, walks embellished, as much as metal and stone can embellish the human form. She takes advantage of her bare feet to place rings upon every toe, of her short skirts to carry a set of anklets, of her open dress to exhibit necklaces and pendants, of the absence of sleeves to display bracelets and armlets, and invariably disfigures her face with a nose-ring, or nose-brooch, and earrings in profusion as well. Among the wealthy there are fanciful ornaments in the hair, which is long and carefully dressed, resplendent zones, and innumerable baubles of a minor kind. It is rare to find one lady taking advantage of all these adornments at once, but they are to be seen occasionally. In some cases the arm from wrist to elbow is almost covered with variegated bangles of silver, gold, coral, bone, and other materials; there are several more above the elbow, while six or eight anklets about each foot keep up that tinkling which roused the wrath of the prophet Isaiah against certain daughters of Jerusalem.

The nose comes in for very bad treatment everywhere, the least offensive being the fitting of neat pearl stars in one or both nostrils, but there are in some districts solid nose-rings of the size of small watches, and others, lighter and finer, so large in circumference that they fall below the chin, and can be rested upon the crown of the forehead. The owner probably eats through them, and can almost pass her head through them. It is said that the natives do not kiss, and certainly one would judge so from their reckless habit of putting obstacles in the way. Now and then the nose-ring is drawn a little aside by a light chain or thread fastened to the ear. That organ, however, is even more deformed and has greater burdens to bear, the lobe being sometimes, as in South Sea women, dragged right down to the shoulder by the weight of more than a handful of filigree-work and fringes. It is fortunate that there are no more opportunities of distortion and mutilation afforded by the human shape. A dowry largely takes the shape of jewellery, and the custom leads from time to time to murders of which robbery is the motive. This knowledge appears to exercise no deterring influence, for even the poorest woman who is picking up droppings on the road, or carrying bricks for wages, has her bangles, her anklets, and her nose-ring of silver, if not of gold. Before reading a homily to them it is advisable to recollect how far the same savage practice obtains in our own country. Those white women who are fond of appearing in full undress might note that even the Changas or gipsies and other low caste women, though not completely apparelled, are careful in every case to have a covering for their breasts, and that no Hindu woman under any circumstances wears false hair.

In giving currency to even a passing judgment upon manners and morals, it is, of course, essential to speak with the greatest diffidence. It is with servants and people of that class that all whites come most in contact. Strangers meet no others. Hence the denunciations frequently unjustifiably hurled at the whole

population. Those who wait upon Europeans and work for them are always relatively low in caste, low in morals, and low in self-respect. Their tendency to lie is said to be universal, and detection awakens no shame; the tendency to bribe and be bribed is also said to be universal, and even two or three native judges were about to be tried on charges of that nature at the time I was in India.

The almost incurable tendency to corruption of the lower castes. who act as police, messengers, or minor officials, assists to make the Government hated. The Hindus themselves complain bitterly of the bribery, favouritism, and blackmail practised by them, and from the testimony personally given to the writer it was clear that they had good cause for their reproach. A magistrate confessed that in cases between natives his practice was to ignore the evidence on oath tendered by both sides, and determine the cause on the probabilities, by intuition. A railway engineer declared that nine-tenths of the complaints upon which he adjudicated were either partially or wholly false. A pretended crime is sometimes dramatically rehearsed by men, who then proceed to perjure themselves with the utmost circumstantiality, in pursuance of a private vendetta. The police themselves are notorious for their venality and tyranny. Every native railway station-master must be tipped before he despatches the ryot's grain, and when famine prices reign the douceurs necessary to obtain trucks rise proportionately. The mill licences on the Bari Doab canal, though sold by public auction, are bought by a ring at their own figure, and afterwards distributed among the conspirators. The timber floated down the Sirhind was not only purchased by native rings, but resold at their own private auctions the same day, and the profits divided among the operators. Cupidity, cunning, and lying go hand-in-hand among the lower castes to such an extent that the task of the white officials everywhere is trebled, while they are always certain that much undetected duplicity is proceeding around them. To a small extent some white officials and some high native officers are said to be guilty of peculation and the acceptance of presents, but this is rare, and it is the low code of morality among the mass of small clerical and police officials which becomes in the mass a serious incubus upon the whole Government.

The social structure unmortared, as Mr. Stevenson would say, by these laxities, is rendered stiff and inflexible by superstitions of many kinds, childish, gross, and cruel. These impede progress seriously, and in every direction.

The boldest and most important action of the British Government in this regard was that which put down "sati" or widow burning, and human sacrifice. When the Brahmans informed Napier that these rites could not be prevented, and were essential to their religion, the gallant general bluntly replied that he did not doubt it, but his religion made it equally obligatory on him to hang anyone who indulged in such pious exercises. A quiet but persistent struggle has been maintained with more or less success against the

insanitary practices and dangerous superstitions of the various tribes, but the cause of social reform has been so bitterly resisted, especially by that most talkative, most specious, and most cowardly class, the Bengali baboos, that little progress has been made. The National Congress does not touch subjects of this character, though the bulk of its members form a social congress which sits side by side with it, and openly favours interference by legislation with many native customs. During my visit the raising of the age of consent of child-brides was a burning question, the whole of pious Hindudom being deeply agitated by a proposition to prohibit the consummation of marriage until the age of twelve, unless womanhood had been attained earlier. No proposal to tax the unhappy ryot, or to destroy such liberties as he enjoys, could have excited the fierce antagonism provoked by a restriction of this nature, aimed only at the grossly inhuman practices of Brahmans and their wealthy clients. Fortunately it has been imposed by the British Government, and will prove, it is to be hoped, but the first of a series of measures striking at the barbarities of native life and custom, which have been fostered by their demoralising beliefs.

It is not to be assumed that their superstitions or social system are imposed upon the Hindus merely by Brahmanic ascendency, for, whether by long habit or the turn of their intelligence, these appear to have become inherent. New castes are being created at the present day among the men employed upon the railways, and in other pursuits incidental to modern life. These are no doubt maintained to a considerable extent by the fact that they are often trades unions of a strict type, and of marked efficiency, relying upon strikes and boycotting long before they obtained European precedents for the use of those weapons. But apart from any such advantages, the tendency to group isolation appears to be persistent, though the artificial nature of many of the conditions imposed is a bar to industrial progress. For instance, the well-diggers of Madras will not associate or intermarry with tank-diggers, while the Sikhs will not grow indigo, nor touch tobacco. Their superstitions are also obstructive. Villagers have their rain-makers, in whom they trust, though the more sceptical and speculative residents of the towns prefer to visit their bookmakers who register bets upon the showers. The recent riots in Benares arose because a sacred site was utilised for the city water supply. Irrigation, like every other national enterprise, suffers by absurd local observances. So far there is no sign of any Hindu appreciation of the marvels accomplished almost against the native will. In the season of drought the canals fulfil their duty to the thirsty plains and their tired cultivators, carrying the saving grace of water scores and scores of miles under a blazing sun, and spreading it over thousands of arid acres, to clothe them with harvests, and fill their people with plenty. Human capacity cannot claim a more humane achievement, its gains won, not by strife with man, or to the loss of any living thing, its gifts drawn from the superfluity of the mountain, and saved from swelling the over-abundance of the sea. Yet caste rules do not

consider it, and no divine revelation is recorded, although much needed, for the improvement of native implements and engineering.

In perception quick, in reason slow, in conscience weak, and in matters of practice affected by faith obstinate, suspicious, and sullen, the average low caste man, in his every-day life, is almost always an idle, shiftless, and careless creature, noiseless, docile, good-humoured, and servile. He does one thing and one thing only, but he will not do it well, and the brigade which the Anglo-Indian maintains are far from able to secure to him the comforts of a European household. Native servants are as cheap to keep as a cat or dog so far as bed and board are concerned, but the number of their petty thefts, small commissions, breakages, and blunders help to make up a fair total at the end of the year. Their temper is placid, and even when the furious master denominates one of them the "son of a pig" he salaams to the earth with the soothing and unctuous rejoinder, "You are my father and my mother."

Their treatment by their masters has improved and is improving, though it is not so very long ago since the attitude of some whites to their domestics partook of a good deal of severity:

> Old Colonel Thunder used to say,
> And fetch his bearer's head a whack,
> That if they'd let him have his way
> He'd murder every mortal black.
>
> In fact, throughout our whole dominion,
> No honest nigger could be got,
> And never would, in his opinion,
> Until we polished off the lot.

Fidelity, affection, and loyalty are not uncommon in family servants who remain in the same employ for many years, and there is evidently a better observance of the moral law among more responsible public officers, as also between the Hindus themselves, though to analyse and estimate these several relations would be a difficult task.

It is sufficient for the present to say that the average morality of the masses is not high, and that it rises in some degree above that of the towns in country districts, though nowhere has it reached a Caucasian standard. There are, of course, compensating virtues which might be taken into account, but that such balancing leads to nothing. Compared with the European, the Hindu is obsequious and suave. He is always deferential to the white, and his politeness is so engrained that it is exhibited even after he becomes a post-office or railway official. His respect is indicated in a rather odd manner, from our point of view, since he is careful always to enter the presence of a superior with his head covered and his feet bare. As a rule shorter and always slighter than the Briton, he eats little, and that little chiefly grain, fruit and sweetmeats—

> Keeping the barking stomach wisely quiet
> Less with a neat than needful diet.

He is far less carnivorous even when not wholly vegetarian, and

more abstemious than the white even if not a total abstainer. Muhammedans and upper-class Hindus are forbidden to take alcohol, though the former smoke tobacco excessively, and occasionally opium and other compounds. Many low-class Hindus drink and smoke whenever and whatever they can. More contented than the Caucasian, less energetic, less aspiring, less independent by far, the Hindu is an even greater slave to those secular social customs which acquire by prescription a kind of sanctity even with a great part of the English nation. The Hindu clerk or peasant will, because it is considered the proper thing to do, betroth his infant daughter to a man past middle age, and celebrate the event by a festivity, to conduct which he takes six weeks' holiday, and to pay for which he borrows as much as he can at 60 per cent. interest. Funeral ceremonies are equally lavish. Extravagances of this kind are so catching that they turn thousands of small proprietors into serfs, or keep them in a condition of miserable impoverishment for years. They have produced such disastrous general results that the Government is even now considering the form of a law which shall contain stringent provisions against usury. It is almost impossible to free the people from such self-imposed sacrifices.

The natives are children in their love of jewellery and display, in their thriftlessness and thoughtlessness, their humours and their credulity, and as children they require to be protected. On the other hand it must be remembered that manly qualities are not wanting in some races whose warriors have done yeoman service to the Empire upon hard-fought fields. The better qualities of the other sex are present, too, as witness the retiring and modest demeanour everywhere of the women of all classes who are visible, their quiet dignity of mien and their unaffected tenderness to their little ones. Such touches make manifest the kinship under all differences between the British in India and the multitudinous throngs who have become in truth their adopted children.

To appreciate the economic value of Hindu labour, two or three peculiarities require to be remembered. In India there are for all practical purposes neither clocks nor calendars. Time is the excrescence of every contract. It is to the native mind a thing immeasurable and of no value. The will of Allah is that the white man should be always in a hurry, always impatient, always demanding that the thing to be done be accomplished according to the direction of the watch which he carries in his pocket, or of the almanac which he hangs upon his wall. Such is the mania of the white man, one which it is well to humour by promises, but which no one having his ease and pleasure to consider will trouble to obey after the pledge is given and peace temporarily secured. The native knows that there will be a storm somewhere in the indefinite region of the "to come," but that is far off. Moreover, the Sahib having said his say must submit, and the wisdom of ignoring his instructions will be manifest if he be induced to offer a fresh premium for the speedy conclusion of the long-overdue task. Time is money in Europe, but in India it is only false coinage. It is

worth so little to the Hindu that he cannot conceive its importance to anyone else. To him to-morrow is a long way off, and next year may never come. His sentiments on this subject appear to prevail on branch railways, and certainly govern his itineraries on all lines. The conception of a time-table appears to be altogether beyond Hindu comprehension. Natives arrive at their starting-point at random, camping contentedly in the great stations of the south, which they transform into caravanserais, or picnicing outside them by the hour, or by the day, until the next train appears and carries them off, packed like sheep in trucks on market-day.

Space, like time, has a different standard to the native. Carlyle considered it impossible to make even a shoeblack entirely happy, but it is clear that he had a white and not a brown skin in his eye. For instance, in real estate, what would not begin to satisfy the Caucasian is boundless wealth among the Hindus—one of whom will live with wife and family in a den no larger than an old "bush" chimney, and without a hundredth part of its light or air, will carry on a considerable business out of doors on a surface as big as a paving stone, including sitting accommodation for himself, or, if a household proprietor, displays his wares in a kind of lidless box stood on end, or a masonry cell of the same dimensions, which in Australia could be used for nothing better than a kitchen cupboard. The peasant will make a living for himself and those dependent upon him on a piece of ground about the size of a milking-yard, or if it be unirrigated on about an acre and a-half to three acres in the south. Yet there is land in many parts of India where it only needs moisture or a little knowledge to bring under the plough thousands of acres of fair quality now lying idle. As the cultivator requires so small a plot, there is still a large margin for the multiplication of his class, and of their productiveness. Meanwhile the population crowds into limited areas, where every inch is occupied, and in bad seasons the little donkeys, resembling Mexican burros, appear to have nothing to crop but their own shadows. In towns the people subsist upon incredibly small wages, and in the country obtain, on the average, no more than is just sufficient to keep soul and body together from day to day. Their condition is one of permanent and apparently irremediable poverty. Of course most of them are unable to make any provision for the future, but then they have little or no desire to make it if they could. Nothing is put by for a rainy day, or, to be more accurate, for days when it does not rain. When they come continuously the harvest fails, and the people simply starve by tens of thousands, as sheep do in the interior of Australia. The ryot dies as easily and as uncomplainingly as the sheep, and leaves as little warning behind him among his kith and kin.

To the reflective such a state of things appears appalling. The Government has made immense efforts already to prevent these catastrophes, which have been attended with a large measure of success, but still the knowledge of the risk run by the peasant makes his lot appear gloomy even to Anglo-Indians. Rudyard

Kipling has painted it in a splendid parody of the chorus in Swinburne's Atalanta in Calydon—

His speech is of mortgaged bedding.
  On his kine he borrows yet,
At his heart is his daughter's wedding,
  In his eyes foreknowledge of debt.

He eats and hath indigestion,
  He toils and he may not stop,
His life is a long drawn question
  Between a crop and a crop.

But, as a matter of fact, the picture is misleading. It is the Englishman who has indigestion and foreknowledge; the native understands neither of these things—his mortgage is forgotten, he will enjoy his daughter's marriage feast as much as any guest—and if his next crop should fail, he will accept the decree of his deities and die without a sense of any special injustice or harsh treatment. Have not millions died before in the same manner, and what is man that he should resist the stroke of Siva? Those who survive will learn nothing from such experience. They will borrow and spend as before, and as before produce cheaply and cheerfully on the very edge of famine, just as they will go on drinking from a stagnant pool while fever or cholera is scattering death in every household. Such ignorance and indifference almost put courage to the blush.

Conduct of this kind contributes to render the Hindu as much a riddle to the Caucasian as the white evidently is to the native critic who spends much of his plentiful spare time in speculating upon his master's inexplicable love of punctuality, truthfulness and labour. Of course if the natives would speak their minds it would be much easier to cultivate a mutual sympathy and understanding: but simple as this seems, it is almost impossible. There is the greatest difficulty in persuading them to express their honest opinions. In spite of persistent efforts, the Hindus have still to be studied from the outside, although the inside view would be much more valuable. Almost insuperable obstacles require to be surmounted before even the Anglo-Saxon resident of long standing can comprehend them. Oriental secretiveness has passed into a proverb. The Sphinx itself does not present a more enigmatical countenance than does the Hindu, of whatever class he may be, to the questioner who seeks to discern his mind upon any matter of moment. His most familiar form of concealment is by unconditional agreement with the interrogator, so as to offer him merely a reflection of his own opinion. This pleases most and reveals least. The effort to read the trend of a European's wishes or ideas before replying to his queries is amusingly apparent in many instances. When this cannot be done ignorance is pleaded or command of English lost, or else an answer is given in vague generalities. It rarely happens that without prompting or knowledge of his interlocutor's mind the native discloses his own. Now and then by the exercise of tact and patience something of his genuine self can be learned. Having, though a mere tourist, once or twice obtained an evidently frank statement of

individual views, the testimony thus given appears worthy of record. What Europeans think of the Hindus we know, but we have yet to learn what Hindus think of us and of themselves.

My first success was with a Brahman, a wearer of the sacred thread, engaged as a railway clerk, speaking English fluently, and whose liberal tendencies were indicated by the very fact that he was taking his son, an interesting and handsome lad, to see the wonders of Jaipur. Natives travel a great deal for religious festivals, for pleasure, or for business purposes, but rarely as tourists or with a view to any educational result. What this Brahman felt most keenly was that the poverty of himself and his compatriots prevented them from improving their status or their minds by travel or education, as they must do to attain a European level. The university fees which he was required to pay for his boy were a heavy burden upon his slender salary, and he earnestly desired their reduction. A cheap English story, having a Turkish hero, and a yellow-backed novel by a third rate author, together with a book in the native tongue, lay beside them in their second-class compartment, and it was plain that father and son were both, as far as their knowledge and means permitted, acquainting themselves with literature. The father was an eager critic of passing political and social events, and showed that the records of the British press and the criticisms of morals and manners which appear in its columns are noted as evidences of the fact that their rulers accuse each other of much the same failings in their own country as are denounced in the native in India.

Politically, he was a warm supporter of the demands of the Native Congress for the introduction of representative institutions throughout India, but was prepared to accept the boon by degrees. After earnestly enquiring into the powers of self-government enjoyed by Australians, he remarked with a sigh that it would probably be a century before his countrymen would be fit to enjoy such privileges. That they would hereafter be enabled to exercise the fullest rights of the franchise and maintain responsible government he had no doubt, his assumption being that what was good for the white man must be equally good in time for the brown. The power was coveted, and so also was the equality with the white, which its possession would ultimately secure. The Home Rule struggle in Ireland was anxiously watched by him, and by those who aspired with him to a similar policy for India. He quoted triumphantly the confessions of leading politicians, that classes of voters in Great Britain had not always enjoyed the franchise, but nevertheless had finally received it. Not every Briton who now possesses a vote could be alleged, said he, to be as wise, just, disinterested, and patriotic as he ought to be. It was, therefore, only a matter of degree of qualification as between the London or county elector, and the Hindu who ought to become an elector when he had attained the same standard. But for the poverty of his people he seemed inclined to think that the qualification required might soon be gained by them.

His attitude on religious questions was also liberal, but a shade more conservative than in politics. He admitted the unsatisfactory condition of the popular faith, and looked forward to great changes in it, not to any conversion from it to other creeds, but to its gradual development into a higher form. When pressed as to contradictions and differences, he asked, with some sharpness, whether Christians have no sects which oppose each other, while they nevertheless maintain their unity in faith. On the worship of idols he was even more sensitive. Men must have idols; if you destroyed one they would take to another, and again turning the tables, enquired, "Have Christians no idols? Have Catholics no saints and no images?" He referred to the Parsis with some little bitterness as men who, forsaking their own habits, had only adopted those of the Europeans which are least worthy of imitation, and condemned the Brahmo Somaj innovations in the same strain as deficient in patriotic and national feeling. It was natural that as a Brahman he should be strongly opposed to any great or rapid innovations in Hindu belief, and deprecate too sudden a reformation. He dismissed at once any suggestion that it could be ousted or eradicated, but declared himself willing to aid in purifying it, and removing its superstitions from time to time. What we want, said he, is not profession of a creed, old or new, we want practice; our religion teaches us to do good, let us practise that first, and then we can consider doctrinal questions one by one as they arise. Once more he concluded with a question, "Do Christians practise all they preach? Are they all perfectly virtuous? Must not they develop also?"

In social relations he was an ardent supporter of reform, desiring the abolition of infant marriages, and the establishment of a new order of domestic life and female culture, though still insisting that progress must be slow and partial. He confessed with a little regret that the caste system was being steadily sapped, and more particularly added, with a certain sadness in his resignation, that the privileges of his own order in which they had entrenched themselves for centuries, and by means of which they had made themselves absolute masters of the lives and minds of the people, were being surely, though insensibly, dissolved. In Bombay the goldsmiths and bankers were already selecting men of their own order to officiate as their priests, and other castes would probably follow their example. Under the British law the Brahman had no redress against such usurpations, and was obliged to tamely submit to see his functions exercised by men not born but elected to the office. Let this procedure spread sufficiently, and the caste system as a whole would eventually be destroyed. Personally, he would not resist this transformation if it were carried out without removing altogether restraints that were necessary for the proper performance of their duties by those released from the old form of obligation. At present he lamented the fact that those who ignored caste and hereditary faith were adopting no other law in their stead, but simply taking advantage of apostacy to indulge in licence and debauchery, without any guiding principle.

But for his faculty of putting awkward questions of the kind with which Friday battled the proselytising zeal of Robinson Crusoe, the Brahman was an agreeable conversationalist. His position was entirely liberal, but he deprecated hasty attempts at change, taking into account at every step the conservative habits and temperaments of his people. He was a reformer who trusted to reformation from within, not adopting the ungenerous independence which refuses assistance from without, but, on the contrary, expressly courting it. Europeans, he said, differ much among themselves; not all are wise, not all are good, not all care for the native; there was an evident bitterness in some of his recollections of their treatment of his race, but he hastened to add, with warmth, "It is upon the good and great Europeans that we must depend for our elevation. They must lead us; we have no leaders as yet, and we cannot accomplish our enfranchisement of ourselves alone."

A wealthy Muhammadan landowner, in the North-west, who was possibly a native magistrate also, and on that ground perhaps biassed by Government influences, adopted a different attitude altogether. Not more intellectual nor more refined than the Brahman, his manner exhibited far greater force of will, desire to command, and consciousness of personal authority. Dressed exactly in our fashion and with good manners, he did not forget that he belonged to a ruling race, which, although still in a minority, would certainly seize the reins of power if they ever fell from European hands. Schools, he said, were established in his district only when he was a young man, and therefore his English was a little laboured, but he quoted Saadi in Persian, and was evidently a thoughtful and well-informed man. He spoke of the Congress movement with some impatience. The mass of the people could not be entrusted with the franchise, and if they were would probably seek to take advantage of the minority. He looked forward to the higher education of the followers of Islam, and appeared to regard their future with confidence. Perfectly polite, he was less deferential than the Brahman, and it was evident he regarded himself as the superior of any Hindu, if not as the equal of the Caucasian. Eager for information and quick of apprehension, he had a decided set of opinions on all questions, and summed up the dangers of concessions to the Congress party by quoting a pithy Oriental proverb, "Teach your servant the bow and he will soon point his arrows at you."

The most interesting chat, however, was with a Banya, of Bengal, a member of the caste hereditarily devoted to banking, money-lending, and similar business. His position was that of an employé, and he entered the carriage only because having arrived at the last moment, after the window had closed, the station master had refused to sell him a third-class ticket. As he was hastening home because of his wife's sudden illness, he had no alternative but to pay the extra sum, though he could ill afford it. Probably he, too, was a supporter of the Congress, but at this time his mind was running more upon the social and economic aspects of his situation. "What can we do?" he asked: "we are too

poor for anything; we should improve our husbandry, but what does that require?—money for implements, money for improvements, money for machinery, money for manure; and we have not got it. We cannot educate ourselves, we cannot travel, we cannot improve our houses or our modes of living, for we have no money. Government, without intending it, makes our lot harder. My wife is ill, but there is no one to attend her unless he has a diploma, and he charges many rupees for seeing her and more for expensive foreign medicines. Formerly there were native physicians without diplomas, but with long practical experience of us—not good surgeons, but good physicians for most of our ailments. They received large fees from the rajahs and the rich, and they treated the poor for nothing. Now they are gone. Every one must have a diploma and every one charges; native medicine is forgotten, and those who cannot pay the fees see their wives and children die unattended. We are taught something in your schools, but it is little, it is only a smattering of a few things. Before, we had what we wanted. All we needed came from our fields. Now we must purchase. We know of many new things, we have come to need many of them. We have many new wants and we cannot supply them. The world believes India to be rich, but only few are rich, the many are poor—miserably poor—so poor that we are crushed and dispirited, and have no heart for effort. We have no prospects; we have no hope.

"Europeans are clever, but they do not understand us, and often there are false reports sent to Government by officers who are careless or who are prejudiced. Government means well, but not always does well. How can it know?—all its people are not just, all are not kind, but it is, for the most part, our own fault. Our ryots are idle and ignorant, they are suspicious, they do not tell all the truth, they conceal their real position. We cannot do as Englishmen do, but we imitate their vices. You see no Europeans drunk in the streets, but you can see many Bengalis; for they cannot endure the white man's liquors. The Shastras say that only those who have self-control and can be moderate should drink such liquors—those who can use without abusing them. Then our landlords are not like European owners, who improve their lands and help their tenants to improve. Zamindars take everything and leave nothing, and in bad years many ryots starve. This is a bad year, the ryots can scarcely live and the Zamindars will get nothing. There will many of them be ruined, and so all suffer because we have not knowledge and do not help each other; that is our fault.

"The root of this is that we learn from the English to doubt our own religion, but we do not learn to believe theirs. Many of us now have no religion and no caste, and many are ruined. Morality is what we need most of all, more than education. We can be nothing without morality, and we cannot have morality without religion. We were better when we were all Hindus, before we learned so much. I am a worshipper of Vishnu, but not a Brahman.

I believe in God, but He is far up, high, and man is far down, low, and we need someone to come between us. Some ask Siva, I ask Vishnu. The Brahmo Somaj have given up too much. They are too European; they believe only in the far-off one God. We believe in Him, too; but we do not neglect the gods that are nearer. Vishnu is full of love. We need someone to love us, who will stoop to us and help us."

It was my mission to listen, with as little comment as possible, so as not to check the flow of speech, and consequently I passed by the fact that I had seen no Bengali intoxicated, and that there had been landlords, in Ireland, Scotland and elsewhere who had failed to realise their duty to their tenants, and only referred to the likeness between his view of the necessity for a mediator or intermediary and that of Christianity. The man was thoroughly in earnest, and asked no questions, a very unusual thing with natives, who are always consumed with curiosity, and almost impertinent in their desire to satisfy it. He was speaking from the fullness of his heart, gratified at finding a European listener, and without the slightest knowledge that what he said would ever reach any other ear. He had a refined face, lit up with zeal, a very plain but clean robe, and an imperfect command of English, but he became eloquent when he learned he was speaking to an Australian, and exclaimed, "Tell the people far away, tell them that we—the masses—in India are poor, are ignorant, are wretched beyond all conception of theirs, and that we need all their wisdom and their assistance to lift us up, to give us courage, and enable us to live as we ought to live and be what we ought to be. We need teaching and help—much teaching and great help." Above the noisy rattle of the train rose the eager voice, and under the dim light of the lamp shone the gleaming eye, as possessed by a profound sense of the poverty and weakness of his countrymen, and of the wealth and strength of the white, he uttered his despairing wail.

Whether our race would achieve much if situated as the Hindus are, living in abject poverty of possession, education, freedom, and opportunity, is a difficult theoretical question. What our race can do to elevate these subject millions, and improve their opportunities, is a practical problem pressing for answer, which must be answered speedily, but to which no answer, at once satisfactory and complete, has yet been discovered. Nor can it be said that we are as well qualified to reply to it or as well equipped for remedying it as the sad-eyed Bunya believed. We have our own poor, we have our own ignorance, we have our own inequalities of society and inequities of its conditions. We have obligations at home to add to our obligations abroad. Parting from us with the refined politeness and courtesy of the east, our native friend slipped out of the carriage into the night at the next station to seek his hut and his sick wife.

It would not have heartened him to learn that we, too, had our grave issues to face and grievous problems to solve, to which his came as a serious addition.

The native life of India is mainly rural, and to convey a concep-

tion of its character and conditions it is necessary to take the testimony of those who have lived it for many years.

General statements are far less impressive and suggestive than the detailed descriptions of particular districts which, however differing among themselves, are much more faithfully illustrative on the whole of the true condition of the country. The zeal and capacity which are brought to the dry duties of administration have occasionally found scope for themselves in literary or scientific work, and the Panjab has been happy in the acquisition of two complete studies of its local conditions, that in the west made by Mr. Purser, and that in the east by Mr. Ibbetson. The report of the latter, both as being the more recent and as more generally typical of the conditions of the peninsula as a whole, may be advantageously noted. The subjects involved in any criticism of India and its people are so great and the issues involved so many that it is only by means of special instances that its problems can be indicated, and their solution vaguely outlined or implied.

Mr. Ibbetson's district was situated to the north of Delhi, close to the Jumna, and partially under its western canal; its chief towns, Karnal, containing 23,000 inhabitants, and Panipat, of historic fame, housing 25,000 among its ruins. The tract contained nearly 900 square miles, of which 400 were cultivated, 300 pastured, and the balance barren, maintaining in 1881 about 330 villages and 262,000 people. The whole of it was alluvial stiff loam, in the hollows called *dakar*, sand in old river beds or wind banks named *bhur*, and a mixture of the two termed *rausli*, all being deposited by the Jumna as it worked eastward through the ages. A low-lying tract, having a sandy soil and water close to the surface, extends from the present stream to a ten feet rise, which marks its utmost flood limits; it is irrigated chiefly by wells, half of it being under the plough, and 80 per cent. of its cultivation irrigated. Above the bank runs a level slope with a stiff friable soil, half of it farmed and three-parts of the cultivation watered by means of a canal. Beyond this again is a higher table-land of grassy plains, intersected by belts of trees and jungle, with only a fourth of it under cultivation, and that dependent upon a rainfall, declining from 28 inches near the river to 18 inches and less in this part, which is chiefly devoted to pasture. In the low-lying land the wells are but a few feet deep, but in the plateau water is not found except at 90 feet or greater depths. The intermediate slope is rich in mangoes, and the river bottoms in date palms and luxuriant groves of trees. At Karnal, there were the finest orchards in Northern India, and there are still throughout this tract many valuable shrubs and natural foods.

From the earliest times the chief events of Hindu history have transpired within this district, or near it, in the city of Delhi, whose varying fortunes it has always shared. It is representative of the Panjab, especially because made the thoroughfare of invasion, the three great and decisive battles of Panipat being fought within its borders. It suffered from these even more than the western territory, and recovered less quickly under British rule. The

early Emperors bore heavily upon its resources, because of its nearness to their palaces; but at least they benefited it by means of canals and ruled it with some degree of consistency. After the overthrow of the Mughal throne it became a no man's land, wasted by Mahrattas and Sikhs alternately, until four-fifths of it relapsed into forest; the few villages that remained were fortified strongholds of predatory bands at war with each other and levying blackmail upon all strangers. The fields were given over to beasts of prey, lions being seen in the vicinity as late as 1827, while tigers seized upon fakirs on the main road. Wolves, boars, deer, crocodiles, and wild fowl still abound in the outlying parts, but when the territory came under the British flag in 1809 they bade fair to be the sole proprietors.

Peace brought back the peasants, but unpardonable misrule by early officials rendered the unfortunate district almost as wretched as in time of war. English rule has not always been beneficent. The taxation was not only excessive, but vexatiously imposed, with the most reckless ignorance and injustice. Every petty chief was permitted to levy transit dues, in addition to the regular custom charges; the police were notoriously corrupt, bandits flourished, the irrigation was so mismanaged as to ruin thousands of acres, while the hapless white magistrate in charge traversed the district carrying all his criminals with him, since gaol he had none. The country once more seemed lapsing into barbarism; the villagers, though as much attached to their homesteads as any people in the world, fled from their ancestral shrines before the blundering exactions of incapable officialdom. The famine of 1824 first opened the eyes of the authorities to the consequences of their tyrannous stupidity. The assessments were revised, and in 1833 again largely reduced. In 1836 old debts were remitted, and in 1842 a regular settlement was effected, which, however inequitable, was an immense improvement upon the former condition of things. In 1847, 1852, and 1856, there were fresh efforts to adjust the burden to the backs of those who were compelled to bear it, and finally it fell to Mr. Ibbetson in 1876-81 to introduce a scientific system under which it was possible for the unhappy residents at last to realise that a civilised Government not only aims at justice, but obeys as well as enforces its commands.

Of the people, 207,000 are Hindus and 55,000 Muhammadans. Until after the mutiny the latter worshipped with their neighbours, and still pay a certain homage to their shrines. The Rajputs raise cattle on the plateau, while the Jats universally, with smaller bodies of Gujars, Rors, Tagas, and Saiyids, apply themselves to cultivation in the lower lands. Individual proprietorship of land was unknown among them until the British *régime* was introduced, and they were equally ignorant of rent. A number of the villages are still worked and all are governed on the communal principle; in some the land is divided according to ancestral shares among the several classes of villagers, while in others the titles of individuals are recognised in a limited degree, relating originally to the use rather than the

ownership of the lands. The misfortune is that here, as elsewhere, instead of developing existing systems for the benefit of the cultivator, the rage for landlordism has led to the blind introduction of the principles of English law, with the most disastrous effect in many cases. The whole polity of the daily life of the Hindus is based upon other lines; the villages are communal in all their habits, and are self-governed entirely in a communal spirit. Hospitality is a duty; food, tobacco, and a rest house are provided in each of them for travellers and officials; they have commonage and its rents; repair their wells and public buildings, such as they are, maintain their local watchmen, and undertake many civic duties. These expenses are made up out of common revenues and common contributions, which are said to be arranged with perfect equity. Agriculture in the same way depends upon association among the people, whether for ploughing, sowing, irrigating, or reaping, and it is their intelligent co-operation alone that makes it possible for them to succeed as they do. Then, again, there are tradesmen, such as carpenters, cobblers, blacksmiths, potters, and others, who work for all in the village and supply their needs by the exercise of their respective crafts, receiving in return certain fixed proportions of the harvest. The taxes in Karnal and neighbourhood are still paid in kind, and services in cultivation are reckoned in kind, so that the profit sharing and social organisation which form the ideal of some political thinkers, are to be found, just as is land nationalisation, not merely in the germ, but in a considerable state of development among our fellow-subjects in India. A wise conservatism would have respected these native institutions and customs, and have sought to encourage their natural evolution and improvement. Unfortunately it was preferred to hamper and maim them, and to thrust upon the peasants so far as possible the harsher and more selfish practices of a commercial people infatuated with individualism, and having for their ideal of action buying in the cheapest and selling in the dearest markets, without regard to those who bought and sold, and who were bought and who were sold in consequence.

The careful redistribution of taxation, realignment of the canal, and construction of public works have now brought the tract to a better condition than it has ever enjoyed. If there is nothing like individual advance or local developments such as are familiar in Anglo-Saxon communities, it has to be remembered that the increase of population is always up to the limit of subsistence, that nothing more than subsistence is aimed at by the mass, and that nothing more is possible to individual aspirants, if there are any such. All are reduced to a level at which practically the whole time and the whole strength of each man are needed to gain his bare bread from day to day. The Indian peasant lives in a mud hut without owning the land upon which it stands, and sees the building collapse in time under the rains, since he can build another upon the same spot, with material obtained from the village tank. By this means tanks are increased in size, and villages elevated

higher upon their mounds every year, and in some old sites have actually risen 100 feet. The peasant owns the utensils of earth and metal necessary for cooking—the latter of brass if he is a Hindu, or of copper if he is a Muhammadan, a few strips of cloth for dress, a few rupees hoarded up for a wedding, and the rest of his small capital visible to the world in his wife's little stock of jewellery. He does not, as a rule, own the land upon which he labours, and the wooden implements by which he scratches it represent a very few shillings. He owns nothing more unless it be an ox or two. His hours of labour are from daylight to dark, with a short rest in mid-day at the summer heat. His food is grain and pulse soaked in water or boiled in milk, a porridge of coarse grain, a pease-pudding, or boiled rice. The women of his family cook, spin, clean cotton of its seed, grind corn, fetch water, and sometimes work in the field. Children are employed as soon as they are able to tend sheep or cattle, or scare birds. All work and always work, and for very little reward.

In Mr. Ibbetson's district, though perfectly willing to perjure themselves for a friend if they believed he had right on his side, and though always prepared to cheat and deceive the white, if not the stranger of their own colour, they are honest in their dealings among themselves, and, so far as he knew, moral also. Life offers them few pleasures; their simple festivals, their little harvests, and their eternal gossip sufficing from year to year. A modest people religiously, they believe themselves too small to attract the attention of the great gods, and accordingly confine their worship to the sun, the Jumna, mother earth, and the god of the home, propitiating fairies and demons, and especially the deities of small-pox and kindred complaints, while carrying with them everywhere a crowd of idle superstitions. Nothing is done without religious sanction—well-sinking, ploughing, or harvesting, are all ushered in by brief and business-like petitions to the unseen powers. The peasants give nothing for nothing, not even prayers. Working at the well-mouth is recognised as dangerous, and consequently becomes a proper occasion for piety. Hence the natives' proverb, with its shrewd worldly wisdom of summary :—"It is a mad world. People call on God only at the well, and twist their bullocks' tails and prosper." There is a certain method in their madness, even in their crudest and most childish beliefs about ghosts, omens, charms, horoscopes, lucky numbers, the evil eye, the danger of yawning, and the auspiciousness of sneezing. They manage to sail as near to the wind of admonition, and as close to the coasts of perdition, as other Pharisees in more civilised communities, minimising self-denial, and cajoling angry deities by judicious bribes to their priests, from whom they obtain a considerable latitude of self-indulgence. By such familiar compromises with reason and conscience one is enabled to discern the relationship of the Hindus to peoples with whiter complexions. They are the touches of nature which make the whole world kin, linking the quiet, submissive, silky-minded Oriental to his Caucasian master, whose brusque manners and

haughty peremptoriness of command might seem at times to create a suspicion that he believed himself a being of another order.

As are the people of the Panjab so are the people of the whole peninsula constituting the base and body of its social pyramid, of which only the apex and surface are coated with a thin facing of conventional civilisation. They constitute the entity to which we refer as "India"; all the magnificence of its mountains, sweep of illimitable plains, flow of superb rivers, and dazzling glory of irresistible sun, furnishing only a background for this bulk of savage life and patient labour. Towns count for little, and the townsman, noisy as he is, for less, in the sum of the national existence. The village and the villager are its real units, and more, perhaps, than in any part of the world the peasant is the typical citizen—the conservative substratum upon which all rests—in whose breast the wild creeds, intense caste feeling, and unprogressive character of the race stand revealed in all their pristine and ever-enduring power. His narrowness, sectarian prejudices, and confidently illiterate ignorance are balanced by homely virtues and gentlenesses, which his chiefs exhibit in a less marked degree. Playing no part in public affairs, furnishing a small proportion only of the ruling class, subject to strange masters, and always the serfs and creatures of those of their own blood who may happen to be in power, the ryots have preserved healthier qualities and nobler traits than their wealthy aristocracies or reigning families. Their lot is the lot of many in most countries—unceasing toil, unnoted pleasures, unrequited sufferings, and unrecorded aspirations. History ignores them, tradition discards them, poetry disdainfully passes them by. And still to have innocently helped to feed their fellows may yet be held more honourable than to have wasted farms or sacked cities; to have reaped the harvest of the seasons, better than to have sown ambition and garnered pride or fame. "We may talk what we please of lilies, and lions rampant, and spread eagles in fields *d'or* or *d'argent*, but if heraldry were guided by reason, a plough in a field arable would be the most noble and ancient arms."

Of the warlike races it is unnecessary to speak, since they have been reduced to the same pacific life as their fellows, unless enlisted by a Rajah among his motley retainers: or they have taken the rupees and donned the uniforms of the Queen. The whole country depends upon its agriculture, and that again in many parts depends upon irrigation. Where the farming relies upon rainfalls there are frequent failures of the crops, and these failures involve hardships and calamities which exhibit a side of the Hindu character already alluded to, but which needs emphasis in this connection. There are parts of the unirrigated interior where the crops very rarely fail, but the black shadow of famine does occasionally touch them, and often lies deep and dark upon the rest. The picture then presented is one of the saddest that ever meets the eye. The passiveness with which the gaunt and wasted villagers meet their death lends it an additional horror. The very resignation of their demeanour

appeals to all the energies of the European, and often, alas, appeals in vain. Conscious innocence, or conscious guilt, might bow as meekly before the stroke of justice, but the Hindu perishes without moral revolt, without challenge of destiny, and even without asking the reason why.

This reminds us that the most striking circumstance in relation to the native population is its magnitude. In parts of Bengal it is denser than anywhere in the world, and over the greater part of the long settled country far exceeds the European ratio. The main purpose of this book is to sketch the superb systems of water supply, by means of which many millions maintain existence upon tracts that without it would only support a fraction of their number. At this stage it is but just to indicate that there is a point of view from which the great schemes appear less admirable in their net results.

As the real mission of irrigation in India is to maintain life, and its success lies in minimising famine, it brings those who would sum up the case for and against it fairly face to face with an old problem of history, pertaining in some degree to all races, but especially under Asiatic conditions. Progress in numbers is readily measured, and at each census the totals of the Indian Empire are enlarged. In 1881 Lower Burmah had 3,670,000 souls, in 1891 it had 4,450,000, or an increase of 21 per cent. It is true that this is partly due to immigration from India proper; but there, too, the totals have expanded. The prospect of a country doubling its population in five or ten years may appear at first sight matter for congratulation. It means peace and plenty, to some extent health and morality, increased production, increased consumption, increased trade, and increased wealth. All these can be predicted of India, whose total population for British and feudatory States alike was 256,000,000 in 1881, and was 286,000,000 in 1891. In the same period Australasia has added 1,000,000 as against this 30,000,000; and though the latter total has been swollen by annexation and improved methods of enumeration, the broad fact remains that the gain in 10 years exceeds the population of Italy or Prussia. Among the most potent means of this rapid growth in the population is unquestionably the irrigation, which not only makes agricultural settlement closer wherever it obtains, but provides the vegetable food of the Hindus for countless thousands beyond the schemes. It may be held to have saved the lives of millions who would otherwise have perished, and to have enabled them to beget millions more, whom it now assists to maintain.

Is this a real gain? Does it deserve the name of progress? Does it benefit either the individual or the race? Many will reply without hesitation in the affirmative; but surely in so doing they confuse the size of a nation with its eminence—they mistake quantity for quality. By multiplying the means of life the multiplication of the human beings within reach of them is encouraged until exactly the same position is restored. When there was food for 5,000 there were 6,000 hungry mouths, and when by irrigation

the fruitfulness of the same territory is increased, making it yield food for 15,000, there will soon be 16,000 hungry mouths demanding to be filled. The man who makes two blades of grass to grow in place of one has always been reckoned a benefactor, and hence it is argued why not place higher the man who enables two human beings to live, where until then only one could be maintained? This, of course contains the implication that life in India is a good in itself, and that the lives of those who are multiplied ought to be held desirable. But is the ryot's life worth living? That is the essential question, to which the fact that he continues to live as long as he can may possibly appear to offer a kind of answer. Measured by a European standard, the reply to the question would be "decidedly not," unless, indeed, it had been put to the Russian Jew, the street-walkers of London, the factory slaves of the Continent, or the seamstresses of New York, to whom the simple animal life of the Hindu farmer might by contrast appear desirable. In what sense can the ryot be said to live? "Half our agricultural population," said the present Governor of Bengal, "never know from year's end to year's end what it is to have their hunger fully satisfied." These half-fed tillers of the soil are numbered by tens of millions. Is it progress to provide them with food which enables them to multiply, and to continue multiplying, until the margin of sufficiency is again reached, and a greater host than ever exist on the very verge of famine, and in the daily presence of possible starvation.

There is no necessity to raise the general Malthusian question. Civilisation implies new conditions and fresh factors. Taking India as it is, it seems as if there is little or no intellectual progress or moral growth among its multitudes. Their condition is so extreme that they have not the means, if they have the mind or inclination, for culture. The ryot to-day is the same being as the ryot of one or two thousand years ago. He literally lives now, as he lived then, from hand to mouth. In mind, character, faith, and practice, he appears unaltered and unalterable. The country is rich, fertile and well governed, but he and his are victims of a grinding poverty, which erases from their existence all but the animal—and often the animal too. New land feeds its thousands, and irrigation its tens of thousands, but they remain the same hapless creatures as before. There are more of them—that is all. It is impossible for civilised man to regard them as locusts or rabbits, though nature deals with them just as mercilessly, and by the same means. Before the Briton came there were periodical famines which depopulated parts of the country. There were frequent wars, insurrections, and rebellions, stamped out with severity. The motto of the successful was always *Væ Victis!* The absence of sanitary knowledge, of scientific surgery, and of simple medical teachings, all contributed to reduce the surplus. These sources of diminution stopped, and famine itself fought off by means of irrigation and railways, the protective measures of the British Government seem after all only a castle of sand upon the shore, which the rising tide of population will inevitably overflow.

There are contributory causes, such as usury, bad landlordism, caste limitations, and superstitions which help to embitter Hindu life; but they may be left out of account. It is possible that they may be altogether removed some day. On the other hand reforms may mitigate, but cannot cure, the world-wide disease of poverty, with all its attendant ills and ignorances, which render the coloured subjects of the Queen in Asia, as Florence Nightingale said, "the saddest sight to be seen in the East, nay, probably in the world." The pressure of population upon the limit of subsistence depresses their level of human life close down to that of the beasts, and keeps it at the mercy of the monsoons. The more peaceful the times, the more fruitful the fields, the more just the law, and the more they multiply. This is the one indisputable result. Is it worth the labour? Such is "the riddle of the painful earth" presented most impressively throughout India. The Spencerian doctrine, that reproduction diminishes as the intellect develops, has little application to the myriads that swarm in Asia. Mental enfranchisement demands leisure, as well as force of aspiration, and these in India appear to be permanently limited, by the mere weight of numbers, to the very few. The struggle of the British Government to raise the masses, like that of the daughters of Danaüs, seems fruitless as well as endless; the courage, energy, self-sacrifice, ability, and benevolence of its rule, idle and without avail. The history of its superb conquest of the elements, like that of its conquest of the country, when viewed from the standpoint of philosophic history, concludes, not with a pæan, but with a melancholy question—*Cui bono?*

CHAPTER III.

PHYSICAL AND POLITICAL DIVISIONS.

The extent of the peninsula and the immense variety of its physical conditions require to be impressed upon the reader at every stage. Its dimensions may be more clearly realised by Australians if compared with the immense expanses of their own land. Its area is equal to that of Victoria, New South Wales, and South Australia united, and the population of any one of its dozen provinces is much greater than that of the whole of Australasia. On our continent there are about 3,000,000 people, while India and its subject States contain 286,000,000. Bengal alone maintains more people than the United States.

Canning's advice to Lord Granville, "Never write or speak of Indian things without looking at a map," is applicable not only to political, but physical conditions, which are as various and often as contradictory. Stretching, as it does, through 28 degrees of latitude from the bleak and wintry flanks of the Himalaya Mountains, through stony plateaux to the rich alluvial valleys of the Ganges or the Indus and the low swampy coast lands of the southern Presidencies reeking under a tropical sun, the peninsula offers almost every possible climate, soil, and product. It embraces the driest and the wettest parts of the globe; deserts as barren in fierce aridity as the Sahara, and deltas as fertile with perpetual moisture as that of the Nile. There is cultivation of some kind everywhere, for agriculture is by far the most important interest, and occupies the great bulk of the people, and irrigation is almost everywhere pursued where the rainfall is heavy as well as where it is light. But the cultivation and irrigation vary in every locality, and exhibit the most evident contrasts from province to province. Hence it is essential that each district should be considered in a large measure separately, and that whatever aspect of life or industry is dealt with, the limits within which the statements made apply must be plainly indicated.

Gallia est omnis divisa in partes tres. This first sentence of *Cæsar's Commentaries*, indelibly imprinted on the mind of the schoolboy, may be appropriately applied in the present connection. Politically India is divided into three Presidencies, Bengal, Bombay, and Madras. Strictly speaking, the name Bengal applies only to the great Gangetic delta which is placed administratively under

the jurisdiction of a separate Lieutenant-Governor, but it also includes technically by its official relations the large and populous territories of the North-west Provinces, the Panjab, Assam, and Burmah, which have as little physical resemblance to Bengal proper as to one another.

The Presidency of Bombay possesses no less variety of climate and conditions than Bengal, for it embraces the Malabar coast, where rain is abundant; the highlands of the interior, where it is irregular, and requires supplementary storage; and the sandy tracts of Sind, destitute of precipitation but made fertile by periodic inundations. While Bengal politically includes northern India from east to west, Bombay comprises the west of the peninsula. Madras, completing the coast on the east and south, presents the same physical contrasts, combining the Coromandel sea slope, in which occur deltaic tracts of unsurpassed productiveness, with stretches of arid territory, in which pestilence has slain its thousands and famine its tens of thousands. As the political divisions determine the titles of reports and accounts relating to irrigation works it is necessary to note them.

But it must be remembered that mere geographic labels are of no importance whatever in connection with irrigation. This is governed absolutely by the great physical conditions of the peninsula. These, and these alone, is it necessary to grasp in order to comprehend its engineering. That the schemes are projected, executed, and controlled by one staff instead of another, or that the reports relating to them are headed with the name of a particular presidency or province, is merely a matter of accident. Nevertheless, the accident is permanent in its effects. One is compelled to deal with the works in groups, which in some instances have a merely artificial connection. In order, therefore, to prevent incorrect impressions, it is essential to unfold and fix in the mind's eye in place of the familiar political map of the three Presidencies and native States, a physical chart of India which shall render the criticism of irrigation works independent of these nominal demarcations. To make this vivid, a certain boldness of outline must be secured, justified by its large and general truth rather than by minute accuracy.

Fortunately, this immense territory lends itself marvellously to such a treatment, for with all its striking varieties and contradictions it falls naturally into a few great divisions capable of being clearly marked and readily remembered. In the first instance there is to be realised the isolation, or what has been termed "the insularity of India." Washed on two sides by the "unplumb'd salt estranging sea," it has been separated on the third side from the rest of Asia by the highest mountain chain in the world. In this there are practically but three considerable passes. The geological, climatic, and productive conditions of the country of the Hindus are distinct from those existing beyond this range. India is self contained, and has been mainly self developed. It is a whole physically, and must be so grasped, although described in detail. Its several divisions are parts of one great whole.

The shape of the country is roughly that of an equilateral triangle resting upon the great plateau of Central Asia, with its apex projecting into the ocean. Along the base, in a great northerly curve, rise the Himalayas, at once the source of isolation, security, and abundant water supply. If the base be bisected and lines drawn thence seaward cutting off the corners of this great triangle, so as to form two smaller triangles on the north-east and north-west, of which the former is the larger, this will leave a diamond-shaped figure of fairly regular proportions in its stead. In other words, lines drawn northward from a little south of Cuttack on the east, and from Gujerat on the west, meeting about Naini Tal, will preduce the result. Pare off a narrow strip of the south-west side and a border strip of the south-east side, reducing the lower and larger part of the diamond, and we have then a picture of the country which will serve with very little alteration to mark almost all its peculiarities. Were the ocean to rise about 1,000 feet it would submerge the right and left upper corner triangles and the southern strips, which we have supposed cut off, and would leave just such an immense diamond-shaped island to be washed by the waves of the Bay of Bengal and the Indian Ocean united to the north across the imperceptible line which still divides the watershed of the Ganges from that of the Indus, as now through Palk Strait and the Gulf of Manaar. Those who are fortunate enough to have seen the splendid series of statistical maps prepared by Sir Edward Buck for the Colonial and Indian Exhibition, accompanied by explanatory essays of pellucid clearness, will be able to readily seize upon this presentation of the conformation of India, which a scrutiny of those maps has suggested. *India est omnis divisa in partes tres.* This is true, physically as well as politically. There is a great diamond elevation in the centre and a northern triangle with a southern strip attached on each side of it.

Such a sketch gives at once certain large contrasts in characteristics which simplify the problem. The diamond is the high interior plateau running through northern and southern India, while the triangles are low-lying plains uniting it to the Himalayan range above, and the strips are sea slopes on either side below. The diamond is rocky, basaltic in the west, and archæan in the east (gneiss schists, &c.), while its pendants are all alluvial. The diamond and the western triangle are arid; while the eastern triangle and both strips are rich in rivers and enjoy an abundant rainfall. Population in its density follows the rainfall exactly. Where it is heaviest there rice is the chief staple, while in the diamond the millets, and to the west and north of it wheat takes its place. The triangles and strips comprise four-fifths of the agriculture of the country, while the diamond has but one-fifth: they include nine-tenths of the irrigated area, while it possesses only one-tenth, and finally the triangles and strips are the territories annexed and ruled by Great Britain, while the independent States cluster in the rest of the peninsula. Kashmir and Nepaul lie in the Himalayas, out of comparison, and the portion of the western

triangle belonging to Rajputana being independent and thinly peopled may be reckoned as part of the diamond. With these slight exceptions, the subdivision stands good and may be accepted as a working plan. The high-lying rocky diamond-shaped plateau of the interior, with uncertain rainfall, small rivers and scanty population, little agriculture, and less irrigation, is under native rulers. The low-lying alluvial triangles and strips, with heavy rainfall, large rivers, and a dense population, cultivating and irrigating on the greatest scale, are under the shelter of the British flag.

The climate of India is tropical, over all the area projecting into the ocean; that is to say, there is an evenly high temperature maintained all the year through, varying comparatively little from one season to another. There is no cold weather, and what is called winter is like an Australian summer without hot nights or hot winds. The northern portion, known as Hindostan proper, forming part of the mainland of Asia, exhibits greater thermometric extremes, the winter being cold enough to admit of the growth of the summer products of Northern Europe, while the summer heat is as fierce and dry, in the west, as that which scorches the caravans of the Sahara, or the interior of Arabia. But for its rivers this region of northern India would have been as desolate as they remain. In Bengal, to the east, the contrasts of the year are less marked, and the heat is moist, producing a wealth of vegetation such as is found in Ceylon. Ascending the Himalayas, the voyager passes from a garden, through a jungle, to the forests of the temperate, and then to the barrenness of the Arctic zone. The regions of perpetual snow are important because of the supply afforded to the rivers, when the rains have ceased and the months of parching heat begin.

Within the boundaries of India there is a remarkable regularity in the direction of the winds, which greatly affects its rainfall and cultivation. In summer the unsparing sunbeams heat the land to such an extent, day after day, that it acquires the draught of a furnace, and sucks in a moisture-laden atmosphere from the sea. This flows lightly up the eastern coast, its clouds breaking heavily in Bengal, before turning inland across the great plains, or rising to condensation point upon the crests of the mighty peaks which stand sentinels before the plateau of Thibet. Little moisture from the west passes the Ghauts, which run close to the Bombay shore, so that behind them one finds a comparatively rainless strip. Indeed, the east coast as a whole is dependent upon the return of the monsoon, when in its autumnal course it sets southward, following the sun. The Panjab derives a somewhat precarious supply from occasional visitations of both monsoons. Regular as these are in their recurrence, they are not regular in the amount of moisture they yield, except in the coast districts, and in the north-east. Everywhere else they fail occasionally, and in some parts frequently. Nothing in such circumstances can stand between millions of people and starvation, except irrigation, and often the means of irrigation suffer too. When two or three such seasons occur in succession the wells in many districts fail, the rain-fed

streams dwindle, and storages shrink. In such cases the last dependence of the hapless population rests upon the rivers distributing among their fields the stored-up waters of the glaciers and snow fields, which, rising half the height of the world's atmosphere, have held it there in suspension for months, or perhaps for years.

The rivers of India play an immense part in its history, for it is chiefly by their action, during untold ages, that the triangles and strips before alluded to have been built up in the first instance, and watered since. As a country India is peculiarly favoured, since not only are the inner slopes of the Himalayas drained to the west by the Panjab tributaries, and to the east by the Ganges and its feeders, but in addition the further valleys on the northern side are tapped by the Indus and Brahmaputra in the same way. Their sources lie not far apart in the heart of the hills. They encircle the whole country, and pour into its plains the priceless tribute of unnumbered peaks and plateaux beyond its pale. The deltas, of the Indus on the one side, and that in which the Ganges and the Brahmaputra blend on the other, are in themselves populous countries of great extent and productiveness. They are represented on a smaller scale along the whole of the east coast, where half-a-dozen great rivers, fed from the mountains of the interior, are engaged in the same unceasing work of creation and preservation. The streams of the west are in the south necessarily shorter and less valuable, but above Bombay the Nerbudda stretches more than half across the peninsula, its source, not far distant from that of the Sone. dividing the diamond into a small north-western and larger southern part.

At least three Indian streams must be reckoned among the great rivers of the world, for the Indus and the Brahmaputra have each of them a maximum discharge far greater than that of the Nile, while the Ganges in flood outpours more than four times as much as the Nile, and half as much again as the Mississippi. It would be impossible to overstate their value to the Hindus. Most of the streams are objects of worship to the people generally, and naturally that river which lies nearest is credited with the greatest sanctity by its neighbours. Doubts may be entertained as to their spiritual influences, and probably it is a matter of indifference to the engineer whether the Kaveri possesses, as its villagers assert, a fourth more power of washing away sin than the Ganges, or whether it is more accurately entitled Ardha-Ganga, half the Ganges. To the health officer ablutions performed under a religious sanction appear to remove no more physical uncleanness than if undertaken for purely secular reasons, and the value of rivers to the irrigator is measured by silt rather than by sacredness. Nevertheless, the fact remains that the material wealth and prosperity, and indeed the lives, of many millions, depend upon these rivers. They win their special honour by the regularity of their flow—a fidelity deeply realised when the earth is iron, the heavens are brass, and those who trust to other sources of supply are perishing fast, beside the empty reservoir, or the dried-up well.

Nevertheless, the area irrigated from canals drawing their supply from snow-fed rivers, is smaller than that from canals running out of rain-fed rivers. In the latter are included many rude schemes, such as those consisting of inundation channels, which have no head works, except perhaps a wing dam or spur, or perhaps a temporary weir, renewed and swept away each season. Those which have permanent works at their head giving a sufficient storage, enabling some of the waters of the rainy season to be retained and disbursed slowly during dry weather, supply a larger area than the inundation canals. But by far the largest area of all is watered from wells either by hand or bullock draught. In spite of the rapid extension of canals and the magnificent works constructed in all the Presidencies, the well remains to-day the source of a far larger supply in India than all others put together. This is a fact not to be lost sight of, since it illustrates two chief characteristics of the country—first the abundance of its water supply ; and next, the cheapness and plentifulness of its labour.

There is water under the soil almost everywhere in the triangles and strips of low lying alluvial land, but at the head of the plains in the Panjab and Rajputana it is usually at such depths as to render lifting too slow and costly even for the Hindu peasant. It is here, therefore, that great canals are to be found—here and in the north-west province (lying to the south-east of the Panjab), where, though the water is at less distance from the surface, it is not everywhere obtainable, and the conditions are specially favourable for canalisation. Nevertheless, even in these provinces the plains are honeycombed with thousands of wells stretching southwards, until the rainfall increases so much in Bengal as to render irrigation unnecessary in most seasons. There are canals for famine protection, special cultures, and navigation in Bengal, but they are not the mainstay of the country in this delta, nor in that of Orissa. Proceeding down the east coast, however, we find other conditions. The rainfall here is far less trustworthy, and each delta in Madras has its works for the diversion of river waters. Where the canals do not reach, innumerable wells have been sunk to take their place, and expensive storages constructed wherever possible. On the west strip irrigation is not required, and within the diamond it exists mainly in the shape of reservoirs, for which the rocky nature of the country offers many facilities, or wells, wherever these can tap a supply. Sind is watered every year by the rising of the Indus, just as Egypt is watered by the annual floods of the Nile, and by means of similar works, except that there is no barrage yet constructed. There is but one perennial canal in the whole of this province.

We have now completed a rapid survey of the irrigated portion of India with which we have to deal. We find first and most often the well. There are wells in the north, centre, along the eastern strip, and in all river or other basins ; river-fed canals in the north and north-west ; deltaic canals in Sind, Bengal and Madras, and reservoirs in the interior plateau, on the west coast sometimes feed-

ing canals, and on the east often dependent solely upon rainfall. The natural conformation of the country has been studied and followed by its inhabitants. Wherever there has been water available it has been eagerly seized upon. Whether by well, by reservoir, or by canal, it has been caught and utilised. Wet cultivation is being carried on in all quarters and in all conditions. In a word, where the rainfall is deficient, India is irrigated in every part where irrigation is possible.

So far as the lessons of irrigation to Australia are concerned a great part of the continent can at once be blotted from the map, and omitted from further notice. The narrow strip in the west between the Ghauts and the sea, with almost the whole of Bengal proper, and Assam to the east, and the territory immediately under the hills, where the rainfall is sufficient, may be ruled out. The whole of the diamond-shaped plateau, except in a few districts, the plains of Central India and the sandy desert of Rajputana offer us little not better taught elsewhere. Bombay has a few schemes which will well repay special criticism ; but only a few. In point of fact a half circle, beginning at Sind and passing up the Indus and down the Ganges valley, avoiding Bengal proper, but sweeping down the east coast to Cape Comorin, comprises the area of India in which irrigation is the most important factor. This is "Irrigated India." Omitting Bengal proper, such a circuit embraces the most populous and most prosperous tracts. Within this charmed area famine finds few victims in ordinary years.

But before considering the irrigation works it will be essential to distinguish more definitely the physical qualities and agricultural facilities of the several Presidencies in a series of short chapters. Their commercial prospects and the characteristics of their tribes cannot be ignored, although it will only be possible to take a hasty glance at the circumstances of each province. Before doing so, it will be convenient to take a general survey of Ceylon, which also comes within the scope of this work.

CHAPTER IV.

CEYLON.

Ceylon, the "Serendib" of the Arabs, the "Lanka" of the Hindus, and the "Taprobane" of the Greeks, has always enjoyed a romantic reputation. It is thus described in the seventeenth century, in *Purchas's Pilgrimage*:—"The heavens with their dewes, the ayre with a pleasant wholesomeness and fragrant freshnesse, the waters in their many rivers and fountaines, the earth diversified in aspiring hills, lowly vales, equall and indifferent plaines, filled in her inward chambers with metalls and jewels, in her outward court and upper face stored with whole woods of the best cinnamon that the sunne seeth; besides, fruits, oranges, lemons, &c., surmounting those of Spaine; fowles and beasts, both tame and wild (among which is their elephant, honoured by a naturall acknowledgment of excellence of all other elephants in the world). These have all conspired and joined in common league to present unto Zeilan the chiefe of worldly treasures and pleasures, with a long and healthfull life in the inhabitants to enjoye them." While the picture cannot be accepted as complete, it errs only, as most panegyrics do, by omission of the facts which would modify the eulogy.

The island is a little more than three-fourths as large as Ireland, pear-shaped, and consists of an extensive belt of plain, largest to the north and east, surrounding a central mountainous area in the south-west, whose peaks, from 6,000 to 8,000 feet high, rise suddenly from the rich flats below clothed with an unrivalled profusion of tropical foliage. It differs from India, in that its history exists in a rhyming chronicle—the "Mahawanso"—from some centuries before our era; but it exactly resembles India in that from the earliest times it has been subject to constant invasions, which have long confined its original race to the hill fastnesses, and given to its most fertile portions a changing series of conquerors. The Portuguese and the Dutch preceded the British in their suzerainty—the first distinguishing themselves by their ferocity, and the second by their servile greed. Kandy, the ancient capital, was not finally taken by the British until 1815, and its great natural advantages as a stronghold destroyed in 1820 by the splendid road which winds up its precipitous heights and spans its foaming torrents. Up till this time the place had been fortified by means of plantations of native thorn, entered only by wooden gates

covered with the same prickly protector, strongly guarded and perfectly impenetrable to the people of the plains.

Those by whom Ceylon has been considered a Crown colony of Oriental stagnation, where a despotic but indifferent Governor presides, on the one hand over a handful of effete Europeans enervated by the climate, and upon the other hand over a great body of natives hostile to every form of change, both classes being entirely excluded from participation in the government of the country in which they live, are cherishing an unpardonable delusion. The natives, it is true, have multiplied rather than advanced, the planters have had a keen eye to their own interest rather than to that of the coloured races, and one or two of the Governors have spent their terms of office in mere routine; nevertheless, these have not been the most prominent circumstances in the recent history of Ceylon. The representatives of the Queen have for the most part striven hard to do their duty, and as a rule they have been supported by their white, and appreciated by their brown subjects. The industrial vicissitudes, which have here succeeded each other with rapidity, have only developed among the planters a courage and an energy which reflect honour upon them. Through times of prosperity, and times of depression, the Government has pursued its way, and undauntedly coped with each crisis as it has occurred. From one motive or another the leading natives have joined to some extent in the forward movement from which they have incidentally benefited. In spite, therefore, of a few palpable blunders and some intervals of paralysis, the island has been steadily progressive, and has evolved by degrees a progressive policy worthy of the examination of self-governing colonies.

The population of Ceylon has more than trebled under British rule, and its production has several times trebled. Its revenue from all sources, including railways and water supply, amounts to £1,500,000, two-thirds of which is received for services rendered, and only one-third of which is raised by taxation. Optimists claim that neither race of the inhabitants have suffered from this burden, and that if the Secretary of State for the Colonies assents to a proposal now before him for a further reduction of the grain excise, neither race will know that it is taxed at all. There appears to be some ground for this contention. Certainly the indebtedness of the colony is insignificant, since it requires to find interest upon only £2,300,000, while its railways, upon which £4,600,000 has been spent, pay interest, have repaid a considerable portion of their original cost, and would now sell for much more than the total of the colony's obligations. Financially, therefore, the position of Ceylon is strong and its future hopeful. As a rule its soils are less rich than those cultivated for the same products in India, but constant moisture and constant heat give its climate the effect of a forcing house, and render production equable as well as large. The cost of irrigation and the rent of land to the Government are less than the average in the peninsula. In brief, while every prospect pleases as much as in the days of Bishop Heber, the more

humane conclusion has been arrived at that man is not viler here than elsewhere, and this has been coupled with the further conviction that his labour can be made very profitable to himself and to the empire.

The Sinhalese are a handsome race, erect and with a graceful carriage, light brown skins, expressive eyes and finely marked features. Their effeminacy is revealed in their history and in their appearance, for the men not only wear a petticoat-looking garment, but have their long dark hair fastened up by tortoiseshell combs. So averse to sustained effort have they become that they have submitted to many foreign masters, and the necessary labour, to reap the fruits of their fertile soil and generous climate, has been derived for centuries from the mainland. Their bolder and more independent relatives of the mountains are of a stronger type, mentally and physically, but are somewhat less graceful in figure and face. There is nothing in their kindly countenances to indicate that the people of the coast have indulged the vices of feebleness and spite, and those of the hills a treachery and cruelty which render their annals painful reading to this day. Yet such is the case. The sure basis of British rule has been its insistance upon the democratic doctrines of personal freedom and equality before the law. Until these were established the chiefs exercised an absolutely despotic authority of the feudal type, relieving their endless struggles for pre-eminence among themselves by uniting to degrade and oppress their vassals.

In this entire subjection of the people to their chiefs, one notes a striking resemblance to the social condition which existed in the Fijian group before annexation, while the irrigation for rice in Ceylon, in little valleys terraced into beds, so that the uppermost when overflowing feeds the lower, and this again a lower still, is an exact copy of what is found in every village of Viti Levu. In civilisation and intellectual development, however, the Sinhalese are greatly the superior. Constituting three-fifths of the population, they are mainly to be found in the south and west. The Tamils, who furnish another fifth, are a darker, shorter, less comely, but more energetic race from Southern India, who had by successive conquests made themselves masters of the northern and eastern coasts, before the advent of the British. Besides these permanent settlers, there is every year a large influx of their relatives, who come to the island during the busy season, and return to their homes as a rule after it is over. The steamers between Colombo and Tuticorin carry 200 or 300 of them each trip, giving them space to squat forward for the eighteen hours' voyage for 1s. each, providing they have booked beforehand at the company's office. A considerable number find their way to the northern districts of Ceylon, across the chain of rocks and islands known as Adam's Bridge, by the help of native catamarans. The total number who entered the island in 1888 was 78,000. They are, therefore, to Ceylon what imported labour has been to Fiji since Sir Arthur Gordon required the payment of taxes in kind from the Fijians, and thus deprived the planters of the local

supply of hands. Their industry and perseverance render the Tamils as much more valuable as hired workmen than the Sinhalese, as were the Solomon Islanders and the natives of New Britain, than the Fijians. Another noticeable element in the population of Ceylon is composed of the Moorish Muhammadans, who form the larger proportion of the merchants, traders, and shopkeepers.

Ceylon has ever been famous for the richness of its vegetation, and its capital is appropriately swathed in bud and bloom, so that it becomes hard to say where Nature ends and Art begins, where the wild ceases and the garden commences. The rich dark reds and burned browns of the tiled roofs of its native town rise from beneath and between a long belt of palms, that lift their feathery foliage in relief against a cloudless sky, above a foam-crested sweep of surf, and a broad strip of yellow shore, "beautiful as an army with banners." Surely the poetess was in error when she declared them not "fair in woods," though certainly she was justified in thinking the palm at its best, if—

> Singly seen and seen afar,
> When sunset pours his yellow floods—
> A column and its crown a star.

Where the white-pillared villas of the Europeans begin the prospect loses none of its beauty, for each residence withdraws itself from the highway into the privacy and shade of exuberant shrubbery. The perspectives of winding roads are avenues of glossy-leaved growth and hanging flower. In size, in populousness, in variety of verdure, in multiplicity of colours of garb, and of tints of complexion, Colombo far outshines her lovely sister, Honolulu, a city which, in flatness of situation, moist warmth of climate, and wealth of tree and blossom, it closely resembles, whose population is as gentle and pleasure-loving, and whose importance arises likewise from its position as a port of call. In Ceylon, cattle do most of the draught work, the large Hindu breed, imported from the mainland, being employed for heavy loads, and the pretty little humped oxen for mat-covered waggons and miniature gigs. But human labour is cheaper and more plentiful than any other, so short, sinewy men run with the jinrickshas, which are the hansoms of the place, conveying a single passenger from one part of the town to the other. Crowded in the bazaar, streaming along the by-ways, eddying at each turn of the road, and scattered over every neighbouring landscape, which they light up with their bright and tasteful robes of white, red, or yellow, are troops of unshod, often uncovered, and sometimes almost naked people. Outside the township a white face is rarely visible, and within it they are very few, though at its busy hours the place resembles in its general aspect an agitated commonwealth of ants. It must be added that the humanity displays a gaiety, and a placable good-humour, not always to be discovered in the ant-hill. Many of the young of both sexes might serve as models for bronze statuary, while a few of the elder possess a dignity of de-

portment, a serenity of expression, and a calm politeness of manner worthy of any society.

The fauna of Ceylon has been famous chiefly because of the elephants praised by Purchas, exported to the number of forty-five last year. In the interior they are still regularly employed for draught, one animal drawing a wide tired cart laden with 2,000 cocoa-nuts. Ceylon was formerly renowned for its game of many kinds, described in the "Rifle and Hound in Ceylon," but this is less common now. The jewels for which it had established a reputation—until the calling of the mail boats induced a number of itinerant traders to establish themselves as purveyors of bargains for credulous passengers—are no longer found in any quantity. Its pearl fisheries are also in a decline, and only its vegetable products maintain their former standard. These have been subject to severe vicissitudes. Fifteen years ago coffee was king, occupying 275,000 acres in 1878, when its export was valued at £214,000. Since a fungoid disease obtained the mastery, area and returns have steadily declined, so that in 1889 there were but 56,000 acres cropped, and an export worth only £45,000. It was characteristic of the planters that no sooner were they satisfied that the reign of coffee was over, than they set to work to destroy their plantations and to enthrone cinchona in its stead. In 1880 they sent 1,250,000 lb. to London, in 1883-84 and 1884-85, the export each year was 11,000,000 lb.; in 1885-86 it rose to 15,000,000 lb. Meanwhile cinchona also developed a disease, and, owing to the practice of growing from seed without sufficient care in its selection, instead of from well-chosen cuttings as is the Javanese custom, production was discouraged, the output fell again to 11,000,000 lb., and is expected to show a greater decline this year, when there are only 15,000 acres cultivated, as against 64,000 in 1883. If, as Mr. A. W. Ferguson contends, quinine is an efficient cure for the opium habit, it may be hoped that the cultivation will not diminish unduly in the island, but will be fostered as it is on the mainland, where last year the harvest of bark in the Government plantations was the largest ever known.

The versatile Ceylon planter, however, has found another idol, and has flung himself into the cultivation of tea with just as much ardour as he did into cinchona, though he is now cutting down its trees to make way for the tea bushes. There are already 102,000 acres in full bearing, as much more maturing, and 10,000 acres just planted, giving a total export this year of 34,000,000 lb. Considering that in 1867 there were but 10 acres under tea, and that in 1878, when coffee was at its best, there were but 4,700 acres, this progress is astonishing. The estimate for the future is even more remarkable, and Mr. Ferguson does not hesitate to say that the island in 1894 will probably send away 70,000,000 lb., and will have by far surpassed the sales of China tea in the English market. The magnitude of the industry may further be gauged from the fact that this year it required the services of 250,000 coolies. It bids fair to excel before long the best coffee year on record.

The third great family beverage is also on the increase in Ceylon, where the beautiful cocoa tree rises far above the close-clipped tea plant and the glossy-leaved coffee when all three, as is often the case, appear on the same plantation. Its area is now given as 12,000 acres, and the export last year was over 2,000,000 lb., while the prophecy is that in 1895 this will have risen to 3,250,000 lb. The spices, which are supposed to pervade the breezes, figure largely still in the Customs returns, cinnamon alone showing an export in 1889 of £128,000. Sufficient has been said to indicate the importance of the planting industry to the colony with its £7,750,000 investment, and its direct and indirect employment of 1,500,000 natives—that is of half the population of the whole island. Those permanently residing upon the plantations are estimated at 300,000, counting men, women, and children. Almost all of them are Tamils, though the Sinhalese occasionally take to tea picking, and some of them are said to have accepted as low as 3d. per day. The general wage is about twice that sum, though as a family is paid as a whole the earnings are not easily divisible. None of the planters' products are irrigated, though some of them employ water-power upon their estates. There is a small export tax upon tea, but it is only imposed in order to pay for the medical inspection of the labourers.

The most valuable products of Ceylon are derived from the palms, of which there are a great variety. Among them they can supply all the needs of the natives, whether for food, clothing, shelter, light, stimulant or sedative. The cocoanut palm is cultivated by Europeans as well as Sinhalese, and appearing in the official figures in many forms, such as oil, coir, copra, arrack, and nuts, gives a total export value of £1,000,000 a year. The Government estimate of the extent of its cultivation in Ceylon is considerably in excess of that of the Messrs. Ferguson, whose firm supply a series of publications upon the resources of the colony, both present and possible, well meriting the high eulogium passed upon them by a recent Governor, who, placing the "Victorian Year Book" at the head of all official statistical records, declared that the handbook of this private firm surpassed even Mr. Hayter. The estimates allow for 550,000 acres, containing 30,000,000 cocoanut trees, a sufficiently magnificent total, even when we are reminded that this most precious of all fruit-bearers covers 3,300,000 acres of the world's surface, and from its 285,000,000 trees yields annually 10,000,000,000 nuts. It is occasionally irrigated, differing in this respect from the coffee, cinchona, tea, and cocoa, which are grown under a sufficient rainfall on the hills. The whole of the crops, which the planter raises and Europe purchases, are obtained in profusion without artificial watering, and the direct interest therefore which Englishmen or an English Government can have in irrigation is absolutely *nil*.

There is but one product that receives irrigation in Ceylon, and that is rice, a food which can be obtained from Bengal and Burmah, where the yield is much greater than in Ceylon, at a

cheaper rate. It is produced and consumed by natives only, since the requirements of the small white population could be more than satisfied by a single shipment in a year. To buy in the cheapest market must always mean to buy imported rice. According to all principles of political economy acknowledged in Great Britain, and also according to the selfish interests of the ruling class, which are certainly as lively in Ceylon as in other parts of the globe, any sanction of the growing of rice in the island should be forbidden, while the expenditure of public money upon works for its encouragement should be stigmatised as utterly indefensible.

The British Government of this tropical colony, however, appears to have set itself the task in this one connection of traversing every accepted university doctrine. It has fostered the growing of rice both by legislative and executive action; has spent public money liberally to encourage and extend the cultivation; and has crowned its edifice of economical heresy by the imposition of an import duty with a protective incidence upon imported rice. That nothing might be wanting which could add to the enormity of its offences and constitute its action the unpardonable fiscal sin, it has placed a small excise upon what is, and always has been, the chief food of its people. To seek to benefit them by taxing the one grain upon which they live, and to procure which they require to devote almost the whole of their labour, and their small earnings, is surely a phenomenon that calls for comment from all sorts and conditions of critics. Yet, in the island the principles of this policy are cordially approved, because they are held to be justified by its circumstances and also by results. The policy has not been accepted in silence, though the challenge which it has provoked relates only to the extent of its application. This challenge fortunately puts us in possession of the reasons why the island has dared to strike out for itself a practice suited to its own conditions and people, notwithstanding its conflict with the mathematical axioms of economics, which take account of none of these things.

The first justification offered is truly Oriental. Rice always has been taxed, and to replace the existing imposts by any other, no matter how equitable, would be to create endless discord and disaffection. Hamlet's preference for the ills he had to possibilities of which he was uncertain, lies at the very root of the conduct of public and private affairs in Asia.

The second justification for the Government's interference is that though a large part of the revenue derived from taxation is obtained from rice, the grower at all events gets his contribution returned to him. There is an excise on rice grown on the island, which yields nearly £100,000 a year. The argument is that as the natives grow and eat the rice which is so profitable to the State, they are entitled to receive back again a proportion of this profit in the shape of grants. Accordingly, under the law, one-fourth of the receipts from excise is set apart each year for what may be termed the ordinary outlay upon irrigation schemes. In addition to this, about another fourth is voted annually for special works, so that one half the

excise is held to be repaid in this way. The proposal now before Lord Knutsford provides for a further commutation of the excise, which, if approved, will reduce the net receipts of the State by yet a third fourth of the present receipts, while it is argued that the last fourth, which would be retained permanently, is only fair payment to the Crown for general purposes and all the indirect expenditure incurred in connection with the management of the irrigating works. The weak point in this calculation is that while all rice growers are taxed, only those who receive the benefit of this Government expenditure have had any return, and these are but a small proportion of the whole body, most of whom receive their water supply from schemes constructed long before the advent of Europeans. In the past no balance of this kind has been kept. From 1884 to 1887 the grain tax yielded £409,000, while the total expenditure upon irrigation was £168.000.

The fact cannot be disguised that out of less than £500,000 of taxation rice alone pays nearly £300,000, an excise of £100,000, and an import duty of £200,000. As burdens should be distributed in proportion to wealth, this is too large a share. The planters contend that as they are the employers of native labour they pay their share of the rice tax in increased wages, but it is doubtful if these are appreciably affected by either the rise or fall of rice. The 6½ per cent. on general imports and a small export duty to cover the expenses of medical supervision of their labourers are all their contributions to the State, in all little more than £150,000 a year. which is not an excessive amount certainly on a capital of nearly £8,000,000. Figures such as these assuredly strengthen the case for a generous outlay upon water supply for the use of the natives.

Further justification—and perhaps it would not be too much to say the real justification—is to be found in the fact that, although the island is exceptionally rich in the cocoanut, bread, and other fruits, as well as in vegetables and yams, which the Sinhalese use, yet rice is their chief food. It produces, at all events, in many parts of the country, the best results for the least labour. Its cultivation has been pursued from immemorial antiquity, and is better understood than any other. The British ruler has been compelled to adapt his views to the character of his native subjects. Rice growing is an honourable pursuit among the Sinhalese, and they would probably refuse to attempt the raising of any substitute. When they obtain little rice they suffer from praraga, a malarious fever analogous to the Italian pellagra; when they get none they sometimes die of starvation. When, in addition, it is remembered that the Government derives so large a revenue from this source there need be no surprise if the industry is fostered to the utmost possible extent, and that the whole weight of the Administration is cast in its favour.

The magnitude of the rice interest, and therefore of irrigation, must continue to force its circumstances upon public attention. The Government returns give 571,000 acres as now under this crop. while those of the Messrs. Ferguson are 700,000, and their anticipa-

tion is that the total will soon reach 1,000,000 acres. The State already exempts from taxation, for four years, land that is being brought under the plough for the first time; by a system of commutation does much to reduce its demands upon the cultivators, and by allowing them to make their contribution to irrigation schemes in labour, instead of in coin, has fostered a feeling of community of interest between them and the Administration. Apparently, therefore, there is not a great deal to be done, and this may be done without much difficulty, to convince the Sinhalese and their fellow natives of the absolute equity of the Government under which they live, and of the sincere desire of the whites for their prosperity and progress. To that desire is due the, at first sight, surprising fact that Ceylon is an irrigating country. The public welfare has been held to be the supreme law, and that welfare has demanded the adoption of a bold irrigation policy.

To form any idea of the vegetable wealth of Ceylon, it would be necessary to sketch the Peradeniya garden, whose 150 acres of beauty are situated about four miles from Kandy, 1,500 feet above sea-level, with a rainfall of about 87 inches. It differs considerably in character from the gardens of which Adelaide, Melbourne, and Sydney are justly proud. As its director says:—"A botanic garden in the tropics is somewhat bewildering to those accustomed to the neatness, order, and regularity of such establishments in temperate countries. The plants grown are mainly trees and shrubs suitable to the climate, and planted in the open. We cannot, as at home, produce artificially the conditions necessary for species of other climes by specially regulated houses, where the different sorts can be classified and neatly arranged for easy examination. Here nature asserts herself, almost uncontrolled. She gives us grandeur of form, wealth of foliage, exuberance of growth and splendour of colour—unfading beauties, but of a quite different kind from those of the sweet summer flower-gardens or the well-kept stoves and greenhouses of England." Yet the curators of any gardens in the world would envy Mr. Trimen the profusion of splendid products which adorn the lovely promontory, washed on three sides by the River Mahaweli. Here are nutmegs, cloves, allspice, cinnamon, mango, bread fruits, cochineal, indigo, cinchona, and black pepper. There rises the giant indiarubber tree, whose roots stand up edgewise one or two feet above the soil, and stretch 20 or 30 feet from the main trunk, writhed like snakes or the prehensile limbs of a gigantic saurian. Hard by is the short close growth of the fairy mimosa, whose delicate sprays only require to be touched by a finger to close fan-wise and droop downward, as if withered, for five or six minutes. The giant bamboos, "tall enough to be the masts of some great amiral," group themselves in most graceful clusters, and thus disguise their enormous size. The calabash and the candle tree stand near the melaleuca, with its eucalyptus-like leaves, and one of the Poniciana, common in Southern India, reminding one of the broad-leaved wattle. There is another extraordinary plant which wears its tiny flowers on and along the edges of its leaves.

The ironwood tree glows like a pyramid of tufted fire, its young shoots burning brighter than the gum saplings and underwood in our early spring, thrown into superb contrast by its dark foliage. An avenue of Royal Palms brings us past its brethren, the Polsuryas and acacias, to a specimen of the wonderful coco-de-mer, whose fruit was washed to the shores of the island centuries before its progenitors were discovered in the far off Seychelles. Here is the Madagascar traveller's palm, no less remarkable for the draughts of water which it yields, than for its perfect fan shape, which would allow it to flourish and attain great proportions in a rocky cleft of a few inches breadth, providing it were high and long enough. Over them all, supreme and splendid, crowned with a flower 38 feet high of white bravery, in shape and colour resembling our funeral plumes for young children, soars the Taliput palm, which, after a life of 50 years, enjoys six months of this sublime self-revelation, followed by six months of fruitfulness, and then, as if content with its magnificent climax, straightway withers and expires. These are some, and some only, of the treasures of Peradeniya, and of the riches and possibilities of this island of the palm and pearl—this "Eden of the Eastern wave."

CHAPTER V.

MADRAS.

The physical characteristics of the Madras Presidency vary in many respects from those of its neighbours. Stretching as it does along the eastern shore of the peninsula from Bengal to Cape Comorin, and from coast plains to the hills, it embraces a considerable variety of climates and soils, but nevertheless possesses a certain unity derived from its configuration. The two great mountain chains which mark the edges of the interior plateau of Southern India differ considerably in elevation and in character. The Western Ghauts rise steeply from the sea, often to peaks of great altitude, receiving a heavy rainfall, most of which they pour down to the Indian Ocean, through thick forests of splendid teak trees and wild gorges, in which roam the elephant, the buffalo, and the tiger. What moisture they catch upon the inner side is despatched by devious ways right across the peninsula to the Bay of Bengal. These streams have therefore a much longer course before them. After flowing along the higher plains, they find an outlet through the Eastern Ghauts, which interpose no formidable barrier, and dashing down rocky ravines, diffuse their waters over the wide Coromandel plain, which they have helped to deposit, and to which they bring most of its fertility. The western coast where the rivers rise, enjoys a rainfall of 200 inches a year, while the interior has but a sixth of that quantity. The whole of the eastern side, except close to the sea, is limited to about 40 inches annually, and this is not always seasonable. The dependence of this low-lying land is therefore upon artificial supplies. The circumstances of its situation permit of irrigation being practised in the deltas of its chief rivers, with little difficulty and excellent results. Upon the inland plateau and its flanks dry farming obtains over considerable areas; but the rainfall there is precarious, and some of the severest famines have been suffered in this region. Though the lower portion of the west coast is politically included in the Presidency, or under its supervision, it has little in common with the two belts, the one high lying and the other low, which comprise its main territory.

The first of these, embracing mountain and plateau, is to-day the residence of some of the most curious tribes of India. In the south are the Puilars, demon worshippers, living in the jungle on the diet described by Poor Tom to King Lear, nomadic Mundavers,

and pigmy Kaders, or hillmen. There are the Erulars, who practise sexual promiscuity; the Keerambars, whose knowledge of simples has procured for them a reputation for magic, and the Kohatars, flesh-eating artisans without castes. Strangest of all are the Tudas, renowned for their high courage, physical beauty, and polyandry, whose creed is a pure theism, who despise the Brahmans and worship in a temple to Truth. There are Hindu castes whose codes are no less peculiar; from those who, being forbidden to wash their vestments, must wear them until they drop off by decay, to those who abjure flesh meats or alcohol, while many are distinguished chiefly by their permissions and prohibitions of alliance. The two chief rights attaching everywhere to members of a caste are those of intermarriage and of eating together. These are forbidden with all who are beyond its pale, and by these restrictions, multiplied endlessly social intercourse is greatly limited throughout India. In addition to this the many separate castes are grouped in Madras into two great divisions, styled right and left handed. Each of these asserts its priority over the other, and maintains it at times even by blows, to the serious disturbance of public order. It has to be remembered that it is under these curious conditions of life that all pursuits are carried on, and all production effected. Hard and fast lines separate the Hindus into sections, isolated and indifferent, if not hostile, to each other, hampering production, trade, and intercourse in every Presidency, and all over India. The institution of caste not merely colours, but actually constitutes. the social fabric.

The bulk of the population of Madras belong to one of the great races of India, the Pre-Aryan Dravidians, who pouring down from the north-west drove before them the earlier inhabitants, establishing once and for all their supremacy in Southern India. The invading Aryans seem to have been afterwards welcomed by them, and in course of time the Dravidians not only came under Brahmanic influence, but by their isolation, numbers, and courage, were enabled to maintain the Hindu faith intact and supreme long after it had been crushed or subordinated in the north by the irresistible torrent of Muhammadan enthusiasm. One looks in vain to-day in Hindostan proper for any temples worthy of the faith of the Sanskrit authors. The earliest and latest Mughal emperors smote with iconoclastic hammer the sanctuaries of the idolatrous races whom they defeated, and built of the fragments stately mosques, which in their pillars and arches still exhibit the defaced images of the multitudinous and deformed deities of Hindu mythology. But it may well be doubted if at any time the architecture of the Aryan Hindus equalled that of the south in size, strength, or richness of phantasy. Indeed one may go far to find a match for the latter. Ferguson admits that, in complexity of design and variety of detail, these southern structures rival those of Egypt. The Saivas and Vaishnaivas, though more opposed here than in other parts of India, can both claim their finest shrines in this Presidency. Much of the sculpture in them is extremely

bold, and the colouring, if fantastic, is striking as well as tasteful in a barbaric way. Perhaps here alone there is to-day a living Hindu art, as strange as the creed by which it is inspired.

Of course the Dravidians themselves have been blended both with earlier races and with later influxes, so as to be now indistinguishable amid the masses of the south, but they have given a language to nearly 30,000,000 of its people, and have created four chief dialects, each of which has its own literature. Treatises on grammar, science, philosophy, and religion abound, while some of the poetry is as excellent in style and as strong in its hold upon the affections of the people as any verse in India. One school is distinctly theistic in its teaching, declaring that "God is one and the Veda is one"; while another quoted by Bishop Caldwell, says: "The ignorant think that God and love are different; none know that God and love are the same. Did all men know that God and love are the same, they would dwell together in peace, considering love as God." It would be scarcely too much, therefore, to say that Hindu art, architecture, literature, and poetry are represented completely in their highest and most characteristic forms in Southern India, and more apart from foreign influence than elsewhere.

The city of Madras stands to-day upon the same site on which the British standard was planted in 1639, and Fort St. George remains with moats, walls, drawbridges, and cannon, to remind the observer how recent was the time when the European foothold in the country, gained by grace, was maintained by force. There is nothing heroic in the history of this capital. It was twice ransomed in its earliest years from native invaders, once captured by the French, almost without a blow, and was only regained by treaty. Yet it was from this inglorious spot, that Robert Clive led out a handful of men who captured and defended Arcot, with such vigour and ability as not only to save the English from expulsion, but to shake the French influence in India, which, with the aid of Coote, he afterwards overthrew. It is needless to repeat a story which has been told by Macaulay, who does justice to this part of the life of the hero, though, as later documents show, he was imperfectly aquainted with some facts of his after-career. The cardinal circumstance is, not simply that Clive was the founder of the Indian Empire, who created it by his indomitable courage, and shaped its policy in the earliest years with an eye to its immense future, but that he at once struck its key-note, and furnished the illustration of what the British rule must be if it were to root and expand. It meant personal ascendancy over Sepoy allies, and their being led with unhesitating dash, and inexhaustible daring.

Those familiar with the life of Clive will realise for how much his personal valour and character counted in the first struggles of Englishmen in arms against French or natives. He won his position at the sword's point, and retained it by his dominating personal influence. The ordinary routine of army promotion, the regulations

as to seniority, the grades of civil rank were all waived in his favour—swept aside by the commanding force of his genius. For the time of his leadership, he was himself the State, the army, and the nation. The same feature re-appears in all the successes of after years. The history of India is more than any other a series of biographies. It is a record of heroes and heroism wherein, every now and then, as in Homeric battles, all has depended upon the courage and ability of a single man. This is the feature, both of the life of Clive and of the history of the country. The second feature was his creation of a native army, without which the peninsula could neither have been conquered nor held. This lesson he owed to Dupleix. The third lesson of his career was that every success must be won by daring—often by reckless daring, and sometimes by almost incredible daring. The reasonable enterprises have as often as not been defeated, and have at best achieved nothing great. The early wars with the French in Madras gave the cue to the only triumphant policy in Asia. Whether in facing the Rajput, the Mahratta, the Sikh or the mutineer there has been but one wise plan, which was to ignore difficulties, defy odds, discard probabilities, and scorn consequences. "To dare, to dare, and yet again to dare" was the watchword of victory not only to the French Revolution but to the British in India from the earliest times to the present day.

Asiatic States may be said always to exist in a condition of revolution more or less suppressed. Revolutionary methods have had to be adopted in dealing with them. Our Indian empire has been erected in defiance of rules, regulations, and precedents. even in defiance of prudence and caution. It is one long record of adventurous zeal and dashing knight-errantry, remaining a protest to the end of time against formalism, red tape, and conventional method. If Clive, Warren Hastings, Wellesley, or Dalhousie had stopped to calculate chances, to make themselves safe. or to shift responsibility, there could have been no empire. In India the better part of discretion has always been valour. The man who has hesitated has been lost. The one principle of safety has been to discard all thought of safety, to grasp the nettle, and trust to the inexhaustible audacity of the race to justify its prestige, and assert the lordship of a handful of Britons over hosts of always armed, often disciplined, and sometimes courageous enemies.

Though India is all agricultural, Madras is perhaps more entirely dependent upon the plough than any of its neighbours. Its capital is therefore fittingly rural in appearance—so rural, indeed, as scarcely to suggest the presence of a great city. There are some fine public buildings, and a row or two of European shops, but for the most part all the places of business are built and situated like villas in their gardens. It appears to be one immense park, over which are scattered many private houses, embowered in trees and ornamented with flowers. There is no point of view from which one grasps the place as a whole, and indeed it is not a whole. Native villages are dotted for miles, with European houses here and there

among them. It is a wide stretch of careless shrubbery, amidst which appears at intervals a commodious two-storied bungalow or a line of native huts. The most dispersed and tree-filled suburb of Melbourne, Sydney, or Adelaide, is as city-like as Madras, the great emporium of the Coromandel coast, whose ceaseless surf lashes the long, flat, sandy shore of its open roadstead.

The Presidency contains over 31,000,000 people, almost all Hindus, living in 52,648 villages, scattered over a territory half the size of New South Wales. Over 35,000 villages have less than 500 inhabitants. About three-sevenths of the area is assessed by the Government, and about two-thirds of this is cultivated. Fortunately for the province, the attempt to create a Zamindar class met with little success, so that but one-eighth of the land is owned by a landlord while worked by a tenant. Tenancy, however, is on the increase since, the population having multiplied 50 per cent. in 23 years, land has risen in value, and men who were formerly cultivators themselves have become able to let their lands and live on the produce. The great bulk of the soil is still in the possession of those who work it, with no other burden than that imposed upon it by the State, and this has diminished by reason of the increased revenue derived from a larger area brought under the plough to meet the wants of an increasing number of consumers. During the 25 years referred to the land tax has fallen 25 per cent.; a great relief of course to the peasant proprietor, but a large unearned bonus also to the Zamindar, who by this means, without any effort on his part, has been presented with a great advance on his income. This bonus must necessarily recur whenever there is private proprietorship of land in progressive communities.

Here, as in the other Presidencies, the greatest pains is taken by the Government to adjust taxation equitably among the people. What are called settlements are made every 30 years, by which fixity of rent is assured for that period. The land and water are dealt with together in one charge whenever irrigation begins, and are not afterwards separated if it should be abandoned. Every year a court is held at which all complaints against the assessment, and all pleas for a reduction of taxation, on account of losses, or unfavourable seasons, are heard and determined with great care. The fact that there are no less than 35 different rates of rent in force is evidence of the desire of the State to study all classes of circumstances. No landlord could be more considerate. The leniency occasionally becomes charity.

A contented and not seldom a thriving peasantry occupy the land; yet it is doubtful if with their short memories any real sense of obligation has been kindled. The past, if it has gained no glory by being far, has lost the grimness of its features. The Rajah's iron rule is forgotten by the class whom he despoiled at will, taking in taxes everything they produced. The ryots were formerly serfs and bondsmen absolutely at his mercy; their possessions his, their lives and labour his on demand.

And these all labouring for a lord,
Eat not the fruit of their own hands,
Which is the heaviest of all plagues
To that man's mind who understands.

The placid eye, the unwrinkled brow, the easy-tempered mouth, are nowhere more multiplied among the natives than in this Presidency. But those who expect any recognition from them of the transformation of their condition under British rule, would find them as ignorant of this as they are of all other history. Nor does it follow that their lot is as much improved as might be supposed, or that their cheerful exterior indicates a high tide of permanent prosperity. The pressure of war and of despotism have been removed, but the pressure of population remains. There are in Madras 16,000,000 people, who live upon an average of one halfpenny per day, the earnings of a family of five persons amounting to about eighteenpence per week. Even in fertile districts and in good seasons, this leaves no margin for indulgences, and indeed provides no more, when eked out by wild fruits and vegetables, than is necessary to keep men alive. Hence the recurrence of famine, and the loss of thousands of lives, and hence the blessings of peace, justice, and good government, bestowed by the British, are rendered of little avail.

Like Ceylon, Madras excels in tropical growths. The staple food and product near the sea is rice, while among the hills planters are raising tea, coffee, and cinchona. Indigo is still one of the most valuable crops, although since 1880 prices have declined 35 per cent. India enjoys a virtual monopoly of this plant, and Madras is first in the list of its exporting areas. Bengal, in spite of its receipts from the north-west provinces and Oudh, has seen its output decline 3 per cent., while Madras in the same period has had its area of cultivation and its export doubled. The rich friable soil, bright, constant sunshine, and heavy rains of the south, combine to bring the crop to perfection. Two cuttings are expected; where irrigated two are certain, and sometimes a third is obtained. It is considered to strengthen the soil in which it is grown, and is often alternated with paddy in the same fields. No less than 500,000 acres have been put under indigo in a single season. On the other hand jute, the chief Bengali industrial product, is little patronised, and there is but one mill in Madras. Horse gram is favoured in the interior because it flourishes in poor soils with a minimum of rain, and furnishes a good fodder. It is eaten by the poorer classes as well as ragi, or millet, a sorghum, which requires a richer soil, and is the better for irrigation. This is rather difficult to harvest, ripens irregularly, and is costly to thresh, but is a popular crop, especially in Mysore, where it is often grown under wells. It is planted by preference in ridges, one row in each side, though sometimes reared as a garden crop. Here, as in Ceylon, the cocoanut trees play a most important part. The shores are lined with their feathery plumes, villages are embedded in their shade; they stretch in columns for mile on mile along the

railway, and are scattered in clumps among the cultivation, or in ranks along the plains. Besides sending 1,500,000 gallons of the oil to local ports, Madras despatches 1,700,000 gallons abroad, as well as 8,000 cwt. of copra. It practically possesses the command of this trade. The only out-turn on the plantations of any magnitude is coffee, introduced in 1830. There are 55,000, of the 86,000 acres in India, in this Presidency; 13,160,000 lb. out of 31,000,000 lb. of coffee being shipped from Madras.

"Keep cool," said St. Just, "and you will command everybody," but if authority were conditioned in this way the Madras coast would enjoy a lasting anarchy. It is now the least heated season of the year, yet the sun shines with a warmth approaching that of a windless summer day in Sydney. An Australian helmet proves altogether too frail to resist it, and no clothing is light enough for comfort. Night brings little change. Just before dawn a cool breath passes over the surface of the languid earth, but as the sky crimsons, an insidious warmth follows hard upon a heavy dew. The fields are green as if in spring, the ryots quietly busy about them as if in autumn, the whole landscape ripe as if in summer: and yet it is the winter of this fecund clime, bathed in perpetual light, swathed in perpetual heat, and steeped in enervating moisture. The senses inhale its exuberance, and are at the same time stimulated and oppressed. There is a hot-house smell of prolific vegetation springing out of damp soil: a soft depth of verdure in herb and tree, a teeming life in sun and shade, waking with welcome bird-calls in the clear, swift, morning rays, drooping in the drowsy silence of tropic noons, and passing into silence again as the suddenly starred night descends in peacefulness, opening the planetary spaces, and all the splendours of equatorial skies.

CHAPTER VI.

LOWER BENGAL.

The province of Bengal, forming the southern portion of the Presidency of that name, may be sufficiently defined as consisting of two deltas and a great plain. First, to the south, is the delta of the Mahanadi artificially watered by means of the Orissa canals. Above this begins the enormous delta, two thirds as large as Victoria, formed by the junction of the Ganges and the Brahmaputra, and still dependent upon their overflow. This is a country of moisture and morass in which the hardier people of the north would fall victims to miasma, but in which the slighter and weaker Bengali lives and multiplies. Macaulay aptly applied to it the Spanish proverb which said that in Valencia the earth was water and the men were women.

Although Bengal was one of the earliest and greatest acquisitions of the East India Company, there is little heroic in its history either before or after that date. The atrocity of the Black Hole of Calcutta brought Clive from Madras; a drunken sailor landing single-handed captured an important fort, securing the passage of the Hooghly; and the battle of Plassey shortly afterwards secured an absolute dominion to the English, who had owed many of the trading privileges they had enjoyed until then to the skill of two of their medical men, and its grateful recognition by the Emperors, Shah Jehan and Farrukhsiyar. The names of Broughton and of Hamilton should be preserved by their country as well as by their profession. Even in the stormy days of the mutiny, the courage and audacity of men like William Taylor kept Bengal in comparative peace. The wide moat and fortified gates of Fort William remain to mark an era of insecurity which has elsewhere left no trace. The Maratha ditch, excavated under apprehension of an invasion, is no longer visible. Calcutta, one of the great cities of the empire, spreads its huge warehouses and spacious mansions around its great park, the Maidan: while its native city, built under the shelter of English guns, is as tortuous and narrow in its streets, as crowded and almost as dirty as if European sanitary ideas had never been permitted to pass the Customs, where a trade of many millions a year is conducted with the uttermost parts of the earth.

As large as New Zealand and Victoria taken together, Bengal contains 70,000,000 people. Of these a considerable proportion

belong to pre-Aryan races of the Tibeto-Burman type, who entered the country from the north-east. Some of these Kolarian tribes, such as the Santals, still maintain themselves distinct from the main body of the inhabitants. The Hindus are twice as numerous as the Muhammadans, but only a fifteenth of them are Brahmans, and at the most a tenth can claim an Aryan origin. English education has been more widely spread in Bengal than anywhere except Madras, and the more active disposition of the people, combined with their residence in the capital, has pushed them into greater prominence than their southern relations.

Their reputation, however, is scarcely enviable. Endowed with the dangerous gift of a trenchant, eloquent, and popular style, Lord Macaulay has impressed upon his countrymen, and, indeed, upon the world, bold sketches of Clive, Warren Hastings, and Impey, which the publication of fuller records is doing much to amend among historians and students, but which have taken a hold of the general reader, such as they are likely to retain for a long time to come. His picture of the people of this province is as bold and graphic as that of the great Englishmen who ruled them. So far it has been less modified by later authorities, though doubtless true of only particular classes, and quite untrue of many individuals. There has never been a Bengali, of Lower Bengal, enlisted in the native army, or who has exhibited any personal courage, except in endurance. Europeans cannot conquer their contempt for a race without this essential of manliness, who have in all ages submitted passively to foreign rule. Yet, conscious of their own cleverness, looking down upon most native races, and surveying their white masters with keen and critical eyes, the Bengalis evince and provoke animosities.

"All those arts which are the natural defence of the weak," writes Macaulay, "are more familiar to this subtle race than to the Ionian of the time of Juvenal, or to the Jew of the dark ages. What the horns are to the buffalo, what the paw is to the tiger, what the sting is to the bee, what beauty, according to the old Greek song, is to woman, deceit is to the Bengali. Large promises, smooth excuses, elaborate tissues of circumstantial falsehood, chicanery, perjury, forgery, are the weapons, offensive and defensive, of the people of the Lower Ganges." The brand has been affixed upon them and is certain to remain.

If Mr. Henry George, instead of indulging for party purposes in diatribes against the British Government upon secondhand information, had carefully investigated the land tenures of India and their history he could have furnished himself with many telling illustrations. That known as the Bengal settlement has not escaped him, but it is made the basis for rhetoric rather than for instructive comparison, and even then has some of its most significant features omitted. In practice certainly, and in principle half-heartedly, the State in India is the sole landlord. The assessment of taxes to be paid by the owner or his tenant is determined from time to time by examinations of the productive power of the

land. The value includes the unearned increment, upon which a levy is then made. In this particular, therefore, the tax asserts a State share in the profits of land ownership, which may be taken at all events as equivalent to a joint proprietary right. The pernicious influence of English practices has asserted itself in a few districts to destroy this adjustable method of taxation. At the close of the last century, after a very rude and imperfect estimate of the lump sums paid by the land in the past, what was called a permanent settlement was arrived at in Bengal, under which it was agreed that the same contribution and no more should be required from this area for all time to come. The right or power of any Government in any one generation to make such a perpetual commutation of taxes may well be questioned. The object was to promote cultivation, and it is claimed that in this respect it has succeeded; but for such an argument to have weight it must also be demonstrated that cultivation is less progressive outside this area. The fact remains that the contribution of Bengal per head is the lowest in India, is only one-third of that paid in Bombay, and that thus the most fertile delta in India contributes £7,000,000 less annually, to the revenue, than its fair share.

This blunder also injured the working cultivators as a whole. Many of the men, made freeholders by a stroke of the pen, were in reality only tax collectors for the areas of which they were then given the supreme ownership. No provision was made for the rights of the millions who tilled the soil and paid the dues. These were practically annulled by an unconditional grant of the fee simple to the Zamindars, and the consequence was that under the sanction of the law the latter asserted their rights to the uttermost. A return furnished to the Agricultural Department of Bengal shows that on certain specified estates the rents had been raised in 50 years from 140 per cent. to 290 per cent. No rack-renting, even in Ireland was pursued more pitilessly, and as a consequence the peasantry of the most productive part of India were reduced to an unparalleled depth of poverty and privation. Sir Ashley Eden described them as the poorest and most wretched class in the country. The famine commissioners speak of them as very helpless, and sunk in the most abject poverty, and the agricultural officers perpetually plead on their behalf for relief and consideration. Zamindars, of this cunning and conscienceless race, have proved the worst landlords, making no improvements themselves, and mulcting those who do make them. A letter is quoted by Sir John Strachey, addressed by one of their agents to a tenant, which runs as follows:—"His Honour, my master, proposes to raise the rents on his estate 5 per cent. in consequence of the recent providential fall of rain; and 2 per cent. more to meet the cess which the Government has imposed upon him in order to diffuse the blessings of education amongst his tenants."

The Indian Government, whatever its failings, has always aimed at bettering the condition of the masses of the people, and its action in this instance has probably been quickened by a sense of its own

responsibility for many of the burdens which crushed the spirit, and degraded the life of the Bengali ryot. It began by an enactment, passed in 1859, under which tenant-rights were created, and followed this by the appointment of a commission in 1879. After bitter agitation against reform by the Zamindars, the Act of 1885 was passed, under which some tenants were converted into perpetual lessees at fixed rentals; provision was made for the unearned increment to be divided between landlord and tenant; the latter were given power to claim compensation for improvements, and in certain cases an appeal was made to lie to the Government against proposed increases of rent. The officers of the Agricultural Department are often engaged in revising rents, and gradually the wholesale plundering in which the landlords had indulged for 60 or 70 years is being prohibited for the future. In point of fact, if the principles, upon which such interferences with private proprietorship are made, be worked out to their natural results, it will be admitted that Indian acts have contributed as much as Irish legislation to sap the foundations of the old doctrines of landownership. Not only is the title of the individual limited, but that of the State is to the same extent asserted. Much more remains to be done in Bengal, and it is understood that further radical legislation is now in prospect. The difficulty, however, is not wholly legislative. The administration, so far as it rests in the hands of native officials, is sometimes corrupt and prolific of abuses. Of the patwaree, or village Government officer, it has been openly stated in the Bengal Legislative Council that he "preys upon tenants and foments dissensions among the landlords. His peculation knows no bounds and his conscience no scruple. He does nothing without a fee, and if for a fee he gratifies the ryot he also for a fee forswears himself to please the landlord." The character of the people, as described by Macaulay, becomes in this way an important factor in their cultivation

Bengal, as a whole, carries 443 persons to the square mile, and is in parts perhaps the most densely-peopled tract in the world. It must not be assumed that all classes come under the ban of the critic. Tribes such as the Santals are noted for their truthfulness and courage, and the great bulk of the ryots are frugal, patient, kindly, and docile. The lower caste Hindus and Muhammadans of the towns, associated with the whites as servants, and the clerks or English-speaking citizens, are those who are most despised. They are often sufficiently under European influence to have had their faith destroyed and their caste scruples weakened, but are neither Christianised nor civilised in the true sense of those words. Possibly the pernicious practices, such as infant marriages, which prevail to the greatest extent in this province, are responsible for the moral and physical deterioration which has taken place among them. Nowhere in India are superstitious observances pushed to a greater extreme, nowhere are orthodox Brahmans more narrow or more bitter; nowhere are well-to-do women more jealously imprisoned or innovations more stoutly resisted. The Calcutta Exhibition,

for a time unlocked many zenana doors by devoting certain days wholly to women visitors, but the influence of that advance is said to be dying out. The bitterest opposition to the Bill recently passed, raising the age of consent of girl-brides from 10 to 12 years of age, came from Bengal, was headed by a native ex-Chief Justice, and supported by meetings, one of which was said to be attended by 200,000 persons, who united in protesting against this most necessary measure for the protection of children against the brutality of men long past middle age.

But with this jealous conservatism there are in all likelihood more breaches of caste rules and more laxities *sub rosâ* here than in less pretentious Hindu centres. The "religion" is scarcely skin-deep, and the "education" is rarely better. With most Bengalis it is merely a matter of memory, a learning by rote, instead of being a habit of mind and discipline of thought. Their mastery even of our language is merely mechanical. The wittiest of Anglo-Indians has sketched this foible of theirs most happily. "When Lord Macaulay said that what milk was to the cocoa-nut, what beauty was to the buffalo, and what scandal was to woman, that Dr. Johnson's Dictionary was to the Bengal Baboo, he unquestionably spoke in terms of figurative exaggeration; nevertheless, a core of truth lies hidden in his remark. The true Baboo is full of words and phrases, full of inappropriate words and phrases, lying about like dead men on a battle-field, in heaps to be carted away promiscuously, without reference to kith or kin. You may turn on a Baboo at any moment and be quite sure that words, and phrases, and maxims, and proverbs, will come gurgling forth, without reference to the subject or the occasion, to what has gone before or to what will come after. . . . When I was at Lhassa the Dalai Lama told me that a virtuous cow hippopotamus by metempsychosis might, under unfavourable circumstances, become an undergraduate of the Calcutta University, and that when patent leather shoes and English supervened the thing was a Baboo." Humorous illustrations of the incapacity of the Bengalis to express themselves abound in their press, but as the incapacity is equally manifest in regard to their appreciation of the ideals and sanctions of modern life in Anglo-Saxon communities, the situation becomes serious, and demands fuller consideration than can be given to it here.

In presence, when not too obtrusively impudent, the well-to-do Bengali is often prepossessing. He is more fleshy than many Hindus, and carries himself with more self-consciousness. His head and face have often an Italian fire and grace. His costume is strikingly like that of the ancient Romans—a robe exactly the shape of the toga being worn in the same manner—a bare head, regular features, and sandalled feet, completing the resemblance. But many Bengalis adopt parts of the European dress; trousers are not unusual, coats are common, slippers or shoes almost universal. There is a fair sprinkling of stockings, waistcoats are rare, hats rarer, and handkerchiefs as little known as in the rest of India.

Possibly there may be a few in the possession of some maharajahs or court officials, but I suspect that even there they are only kept for show upon State occasions.

Such are the town Bengalis, of whom disparaging opinions are expressed. The Baboo produces nothing but words. The country people, though debased by the tyranny of iniquitous landlords under an iniquitous law, are of a better type; they are the cultivators, the irrigators, and the producers, and they are cared for as much as possible by European officials, who protect them as far as lies in their power. The Agricultural Department, though crippled for want of officers and funds, does its best to popularise useful implements, new products, and better husbandry. How much it is overtaxed may be judged from the fact that it has charge of more than 5,000,000 acres of Government estates, and more than 10,000,000 acres of which the State is custodian, pending the attainment of the majority of their inheritors. Altogether it has an area half the size of England to directly supervise, as well as to generally assist and oversee millions of ryots working on tenanted farms. As the late director remarked, when Denmark was spending £9,000, Belgium £15,000, and France and Germany £50,000 a year on agricultural education, it was hard that he should be refused £3,000 to begin the same work on a larger area, for a larger population than any of these, and with larger property in his charge than the whole territories of the first two States.

Yet in former years, in districts where the Zamindars had ground their tenants to the dust, and had left them without resources to face a single bad season, the Government has been known to spend in one season thirty times as much as it received as rent during the year. The absolute injustice of such a policy is a crying evil of magnitude demanding immediate redress. It is not the British Government that suffers alone or chiefly. These enormous sums come out of the revenue of the country generally, the whole of which, practically, is raised from the native population. The burden is therefore made heavier in all parts of India, including those in which a more just land law obtains, in order to save the lives of many thousands who are impoverished by a bad land law, and by execrable landlords. Scrupulous for its reputation, anxious to act honourably to those under its laws, the Government hesitates still to deal decisively with a crisis which it has helped to create. But neither there nor elsewhere can legislation afford to linger. When there are millions to be fed the national interest in the land must be asserted, even if private right has to be proportionately diminished on fair terms. But for the protecting ægis of the British raj the Bengali landlords would long since have been either expatriated or enslaved, by more virile invaders from the north-west. The tenants at least would have lost nothing by the change.

CHAPTER VII.

BOMBAY.

Bombay, which consists of the mountainous strip of the west coast, and the sandy delta of Sind, is the smallest and least populous of all the Presidencies. Omitting the plains of the Indus it is the least cultivated and least irrigated among them, though by no means the least important or progressive.

The people of the country are equally distinct from the Madrasee and the Bengali, upon whose effeminacy they have looked down with contempt for centuries. Some of the hill tribes, such as the Bhils, Waralis, and Khatodis, still remain independent of the Brahman influence and outside its pale, but the bulk of the people are true Hindus. The persistence of Turanian words in their language points to a substratum of that stock, and the character of the Marathas, who are the dominant race, is closely allied to that of Rajputs. They are more temperate and frugal than the castes to the east and north, who retired with them before the tide of Muhammadan invasion, and remained to the last almost independent of the Mughal empire. Biding their time, and cherishing a certain patriotic energy unknown in the Ganges valley, or among the rice-fields of Madras, they came at last to be arbiters of the destiny of the Islamite kingdoms. At the close of the last century the Maratha raids were dreaded, from Delhi on the north, to Trichinopoli on the south, and even the English in Calcutta excavated a ditch in the terror occasioned by their advances. They levied tribute far and wide, upon monarchs and peoples of all creeds and nationalities in India. It was their practice to live upon their farms, during the seasons necessary for agriculture, and when released from these duties to assemble in hordes, armed with bow and spear, and mounted upon sturdy ponies, sweeping down like clouds of locusts upon the territories of their neighbours, and carrying as much desolation in their train. The hills to north and south are still crowned by fortresses in which their chiefs entrenched themselves in times of need. Above every valley, and commanding every defile, the strong walls of their citadels impart a picturesque aspect to the Ghauts, resembling that of the country of the Appenines and its mediæval castles. The villages were all built so as to resist attack, the houses crowded together, and surrounded by a common wall. Dark-skinned, supple-figured, and sinewy, the

husbandman of to-day has still a bolder bearing than the peoples of the eastern water-sheds. The Maratha literature is rich in the poetry of love and war, and contains a certain feudal flavour which, like that of the Rajputs, remains as a memorial of the time when a confederation of Hindus avenged the overthrow of their ancient States, dominated the peninsula, and were only overthrown by the future Duke of Wellington when they were divided by intestine feuds. They were then under Brahman rule, representing the pride, power, and inherent incapacity of the Hindus for permanent political union. With them for the last time the ruling orthodoxy of the country, arrayed with civil sovereignty and complete priestly authority, pitted itself against the white invader, and with them fell the last hope of the native patriots.

The land system of Bombay has features of its own, which distinguish it from a State point of view. While in other provinces the endless subdivisions of land occasion constant labour and expense in the keeping of Government records, this presidency refuses to recognise anything less than what is termed a "field." This area differs in size in different districts, but never falls below 20 acres. A kind of landlordism is thus created in many instances, in which the soil is good enough in these "fields" for a field to fetch a rent over and above that paid to the Government, thus enabling its registered occupier to farm it out and live in idleness. Yet there is no excuse for this introduction of the landlord, except that of convenience of registration. A greater evil still, however, has cast this into the shade. The thriftlessness of many peasants has placed them hopelessly in debt to harsh money-lenders, who have employed the machinery of English law to oust debtors from their holdings with a summariness impossible under native rule. This might have been avoided by rendering the proprietary right of a State tenant mortgageable only to a certain point, and for certain purposes connected with the land, as was proposed by the Longmore regulations in Victoria in regard to selectors' leases. But having encouraged landlordism the Government of Bombay has been compelled to legislate for the farmer's protection, by allowing a court to fix a commutation sum for small debts, and limiting the claim of the creditor for large debts to one-half of the farm, by which the same end is accomplished in a clumsier way. Had the State continued to deal directly with the cultivator in all cases, the land systems of India might have been so controlled as to put the smallest burden upon agriculture, and gain proportionately the largest revenue for the State. So far as the Bombay system has enabled this to be done it has worked well; but wherever the landlord has been interposed, or wherever the tenant has been permitted too absolute a right to encumber his holding, difficulties have resulted, which the Government, by the fact of its legislation, admits to be in need of reformation. According to the testimony of the returns this is but partially attained. Here, as elsewhere, the ryot needs to be protected not simply against the rack-renting landlord, or the usurious money-lender, but chiefly against himself.

The task is difficult, but the Provincial Governments have grappled with it in many forms already. They will never completely master the situation, or place the ryot in safety, until they take and keep a certain State control of the land.

Perhaps the most remarkable feature of this Presidency is the capital city and its municipal government, the one so imposing, and the other so curious, as to merit special attention on many grounds.

The city of Bombay, the finest, and indeed almost the only, port in India, is situated upon an island, which appears to be a promontory, running almost parallel to the mainland, where the eastern sky line is broken by the bold sweep of the Western Ghauts. Other and smaller palm-crowned islets lie under their shelter in this inner bay, where the flags of many nations fly upon a daily-changing fleet of merchant vessels. The island upon which the city stands is narrow and flat, tapering to a fine point southward, whence its fine semicircular sweep to the ocean, faced with public buildings, runs north to where the long bridge of Malabar Hill is thrust forth, creating an outer harbour which has a certain reminiscence of the grace and colour of the Bay of Naples. Vesuvius is absent, and so are the isles of Ischia and Capri. There is no citadel of frowning romantic strength, no *Capo di monte.* Instead of busy quays, there are only some long-prowed native fishing boats, high on the sandy beach, or spreading their lateen sails to the fresh breeze in the offing. Looking from the outer sea landwards the beauty of the scene has no added adornment other than that of the great edifices, the finest in Asia, which face the bay, and of the clustering throng of roofs behind them. A coronet of cocoanut trees rises above the Towers of Silence, and a cloak of verdure spreads unbroken over Salsette. The commerce which is here so great, the enterprise making this port the gate of India, the manufacturing industry firmly established in many mills, the hundreds of thousands of Hindus who live and labour in narrow space, are all hidden, all lost to view except as indicated by the tall spire-like chimneys scattered here and there in the distance. There is a Neapolitan character discoverable in many parts of the town itself, high houses, narrow streets, a varied throng, the balmy air in winter, and near or far the over-powering presence of Nature dominating all.

The European quarter contains a few fine thoroughfares and lines of shops, and more by which one is reminded of the side streets of the Continent. The public buildings are splendid in architectural design, and well situated. The railway station is as beautiful without as many a cathedral of the old world, while the ticket hall within, with its splendid pillars, its lofty arches, and variety of marbles and porphyries, make up a whole which probably, as citizens proudly say, has no equal the world over. There are capacious gardens, and markets, and many public institutions of noble proportions. But it is the native town, where dwell a multitude expected to approach 1,000,000 at the forthcoming census, that is most remarkable after all. Though Calcutta rivals it in size and population, it is distinctly inferior in cleanliness, architecture, or dignity. There are

excellent streets, lined with houses sometimes six stories high, with projecting balconies of carved woodwork of elegant design, often tastefully painted cream, green, white, or chocolate, like a gayer Cairo. Even the temples have a brighter appearance than elsewhere. The horse-trams, crowded with dusky people, run continuously; and the shop interiors are often attractively decorated. Turn aside into the narrower alleys, where the houses tower on either hand, where bazaars are in large buildings, traversed by dark and narrow passages, every six feet on each side occupied by a stall and its vendor, the whole busy, babbling, and yet placid. From these crooked by-ways, or open courtyards, or blind no-thoroughfares, there passes into the streets a throng of men, women, and children, their brown, red, and yellow skins more or less covered with coloured robes. The Parsis, wearing a curious hat covered with American cloth, high in the front, crushed in at the back, and with a narrow rim inward to the head instead of a brim, with yellow faces and usually a tendency to a thickish nose, are noticeable here and there; men who in commerce have exhibited European energy, and who in life and manners are approximating closely to the whites. The remainder are a motley crowd, of many castes, and races. Nowhere in Australia, will one meet as dense a horde of foot passengers as squeezes each evening into this quarter. Into the throng plunge tiny little gigs, gilt and painted in blue, white, and crimson, drawn by a trotting bullock, and crowded with three or four natives. Then comes the carriage of a wealthy Parsi, perhaps with footmen, and probably with both coachman and footmen barefooted, and then the heavy drays drawn by oxen. There are no footpaths and few side spaces, but in between the close walls the whole body of animals and people struggle onward in tho mass. The business done here is something enormous. The stock of cloth in the bazaar is valued at £3,000,000. One of the retailers sells more screws than any other customer of the great English house which supplies him, while recently, after a fire, one ragged trader was found to have lost £5,000 worth of pearls, which he had kept stored in an old handkerchief. It is with this great city rather than its European quarter that local government has to deal.

The Municipal Act of Bombay is a curious piece of legislation. It embodies what is probably the most complex constitution of any local governing body in the world. The powers with which the corporation is endowed are of the widest, while checks and counter-checks are multiplied, so as to provide against possible abuse, owing to the presence of a majority of Hindus on the council, most, if not all, of whom are untrained to, if not unfitted for, the exercise of the powers of self-government. The novel composition of the corporation is indicated at the outset by the 4th clause, which says directly:—"The municipal authorities charged with carrying out the provisions of this Act are—(*a*) a corporation, (*b*) a standing committee, (*c*) a municipal commissioner." The order in which they are named is that of representative status. In the order of their actual power it must be exactly reversed. The municipal Commis-

sioner is an officer appointed by the Government, much as a political agent or resident is appointed to the court of each native prince, with the duty of apparently aiding the ruler with advice, but really of controlling the whole administration. He has a minimum salary of £2,400, with a maximum of £3,000, which must be reached in three years. The corporation may if it so please appoint a deputy-commissioner at a salary of from £1,440 to £1,800 a year, but he has only such powers as the Commissioner pleases to give him. The Commissioner prepares the annual budget, appoints under certain conditions most of the officers, generally initiating and supervising the business of the corporation. A clear majority can secure his removal, and a majority can amend his budget, or negative most of his proposals, but as a matter of fact he is, and remains, the motive power and master of the council.

Then comes the standing committee, which in a sense is the Commissioner's cabinet, to whom he submits his proposals in the first instance, and whose approval he requires for certain appointments, as that of the Senate is required by the President of the United States. This minor body consists of twelve councillors, but even in their appointment the corporation is not untrammelled, of itself only electing eight, while the Government adds four councillors of its own choice. This committee meets weekly, its members being paid £3 for each attendance, with a maximum of £150 a year. For all practical purposes they are the corporation. The municipal Commissioner manages them, and they almost invariably manage the main body. This consists of 72 members, one-half of whom are elected by all adult ratepayers. owners of property who are assessed at the rate of £3 per annum; 16 are elected by the justices, all of whom are Government nominees; 16 are directly appointed by the Government, two are elected by fellows of the University, and two by the Chamber of Commerce. A body in which the influence of the State is so great, directly and indirectly, might, one would suppose, have been given a free hand; but its province is that of consultation rather than action. Meeting once a month, it discusses the proposals of the Commissioner, as endorsed by the standing committee, and gives its formal approval as a rule. The Commissioner can act independently of both bodies if he so desire, but in practice he does not need take any such extreme step. He accomplishes his ends through his associates, with little friction, and only occasional outbursts of opposition. The corporation is considered worthy of the city, and gives satisfaction to its constituents, but with a thoroughly efficient Commissioner it must be a very bad corporation that would not be made to do its work.

The scope of the corporation is far wider than that of any Australian local body yet created, not excepting the new Board of Works in Melbourne. The Act itself not only creates the council, but provides specifically for matters which in Victoria are dealt with under special statutes, such as the Health and Fire Brigades Acts recently passed. There has been thrown upon this body the responsibilities of a city council, the obligations as to drainage and

water supply attached to the Metropolitan Board, the reclamation of unhealthy localities and the abatement of all nuisances, the regulation of cemeteries, registration of births and deaths, regulation of offensive and dangerous trades, maintenance of a fire brigade, of primary schools, and, at its discretion, authority to deal with public vaccination, educational objects generally, libraries, museums and art galleries, parks, gardens, plantations, census taking, and finally "any measure not hereinbefore specifically named likely to promote public safety, health, convenience or instruction." There is no Parliament in India, and perhaps for that reason many of what would be Parliamentary prerogatives are attached to a municipal body, whose constitution is only partially representative, but which creates its own justification since it has so far performed the duties entrusted to it with sufficient wisdom to secure the commendation of those concerned.

It would occupy too much space to consider all the interesting details of the administration of Bombay by its corporation, its fostering care of museums, gardens, hospitals, technical colleges, female scholarships, famine relief and 55 primary schools, in which last undertaking it is aided by the Provincial Government. Taking a liberal view of its duties to the public, and exercising freely the large powers placed in its hands, the council exhibits an energy of self-confidence which appears to pervade the whole city. Although the native members are usually about twice as many as the Europeans, there is rarely any exhibition of race feeling, and as a rule the judgment of the white members carries the day. If the Hindu councillors are not as seized of the importance of drainage and sanitation as their associates, they are even more generous in their dealings with water supply. For this much may be forgiven them. The Act allows a man who might happen to be a fellow of the University, a justice, and a ratepayer at the same time, to vote in each capacity. With this exception, it applies the one man one vote principle in its entirety, and prohibits plural voting. The council does much of its business by committees, electing four members to a joint schools committee, to which the Government appoints a similar number, and has also an hospital committee of its own. The appointments of engineer and health officer are vested in the corporation, but require the approval of the Governor in council. The municipal secretary, or town clerk, is appointed by the standing committee. Finally, in addition to large powers for the preservation of health, the Commissioner can, at his discretion, put the city at any time virtually under martial law, taking whatever steps and making whatever regulations he may think necessary under the circumstances.

Having to face these extra duties, it is of course requisite that the corporation should be furnished with corresponding sources of revenue. The £531,000 income collected in 1889-90 illustrates the progress of the city in those four years by its contrast with the £447,000 raised in 1885-86. The property tax, raised in the latter year from 8 per cent. to 8½ per cent., is responsible to some extent

for the increase, but only returns a total of £166,000. Water rates bring in £95,000, octroi duties give £66,000, a wheel tax £31,000, liquors £14,000, tobacco licences £19,000, and these with market dues, fees, &c., make up a total of more than £500,000 sterling. The valuation of property is £2,194,000, the local debt is £2,909,000, and the yearly payment for interest, etc., £208,000. In the list of assets the waterworks figure most conspicuously, being valued at £2,729,000, a moderate valuation, if measured from a revenue standpoint, seeing that it includes a large amount of outlay which has not yet added to the water supply or increased its receipts. The total assets are set down at £4,261,000, showing a surplus of £1,438,000 after the discharge of all liabilities. Some of the yearly expenditure, it should be noted, is spent in permanent improvements of the best kind. Wherever possible, frontages are purchased in narrow streets, and the houses are set back, as it is termed, so as to enlarge the thoroughfare. In 1889 nearly a square mile and a half was in this manner added to the public domain, to the great advantage of many neighbourhoods, and of the sanitary condition of the place.

Although tariffs divide colonies from each other, octroi or city duties are unknown in Australia. In India they have been a means of revenue from the earliest times. It was a method by which the rulers of towns repaid themselves for their expenditure upon fortifications, and upon troops for manning them. The taxes fall upon all consumers of the articles taxed, which are almost invariably such as cannot be produced in a city. The burden is thus shared by all to whom the city affords protection. In Bombay the duties upon petroleum and small quantities of grain were abolished in 1888-89, involving a surrender of over £30,000 a year. The receipts in 1889-90 obtained from alcoholic liquors were £27,400; sugar, £16,565; ghee, £12,400; gram, 9,800; timber, £9,265; and firewood, £7,400. It is evident that the sections providing for the examination of food after it has entered the city do not remain a dead letter since, in the year under review, 42,000 lb. of meat was condemned as unfit for human consumption. Those who wish for further information upon the condition of Bombay and the work of its municipality will find the annual report published on its behalf a document immeasurably superior to anything of the kind prepared in Australia. A volume of over 500 pages exhibits every phase of its work, and criticism upon the more important branches by responsible officers. The returns even classify the accidents of the year, and note their localities. As permanent memorials of what has been done, and as a means of putting their constituents in a position to examine every item of revenue and expenditure, the Bombay Administration Reports may be commended to the friends of local government everywhere.

In matters pertaining to health Bombay has passed through a severe experience, for sanitary experts have condemned the drainage of city and suburbs in the most unequivocal terms. There is, however, great excuse for the Indian capital, since more than three

quarters of a million of its inhabitants are Hindus, utterly careless of any sanitary considerations, and crowded together as people can be crowded only in Asia, or in Chinese quarters out of it. One suburb has a human being to every six square yards; another one to every eight square yards. The average mortality is nearly 26 per 1,000, but it has to be remembered that this is abnormally swollen by the large number of vagrants and indigent persons, who may be said to come in from the country to die. Out of 603 cases of cholera, no less than 509 were of persons not six months resident. The condition of the city, though bad, is not so bad as the figures alone would suggest, nor would it be fair to compare them with those of any Australian or European city outside Turkey. As the health office piteously remarks: "There is no condition of life so depressing as the life of the Hindu out castes. It is difficult to improve their condition. If they go into good houses or large rooms they divide them, place partitions and make them unwholesome; their poverty and absence of caste-training make them helpless."

The corporation decided to obtain the highest possible advice upon the best method of dealing with the drainage of the city, and their choice fell upon Mr. Baldwin Latham. His scheme is to be carried out almost immediately, and when it is completed the great capital of Western India will have erased the one blot upon its fame. It will probably before long become even more important than now, the development of railway systems in the interior, and a steam communication with the rest of the world, all contributing to its advance. In most respects it exhibits more self-confidence than any other town in India; is proud of being in population the second city of the empire; is noted for the public spirit of its citizens, and their zeal for its corporate honour. It is a city of the future. Rapid as has been its growth, there is no sign that it has yet reached its climax; on the contrary, its industries are expanding, and its commerce multiplying its channels. Beautiful in its surroundings, its position, from a commercial point of view, is almost impregnable. Karachi, the port of the Panjab, is its only competitor. The western interior has no other outlet, and every improvement in locomotion tends to increase its trade. Many years should not pass before it justifies in every sense the proud motto upon its coat of arms, *Urbs prima in Indis*, becoming first in prestige, as it is already first in wealth, enterprise, situation, and beauty.

CHAPTER VIII.

THE INDEPENDENT STATES.

British India is but imperfectly conceived as consisting of three great Presidencies, for as a matter of fact these include some dozen populous, wealthy, and extensive provinces, each with its own people, social order, and white government. They are subject to the Viceroy, as conquered kingdoms might be to a great over lord. Beside them, among them, and more or less under their control, are other provinces in which native rulers exercise much the same kind of limited sovereignty beneath the hegemony of Calcutta, but in whose territories there is neither British law, police, nor officials. These native States are sometimes suffered to drop out of mind by the stranger, though they occupy nearly one-third of the whole country, and include one-fifth of its inhabitants. There is a tendency to confuse the political and military supremacy which Great Britain exercises throughout the peninsula, with the absolute dominion maintained over two-thirds of its area, or else States, which rank high among the nations of Asia, are minimised in imagination, because of the vastness of the territory under English control. These independent principalities cannot be so ignored; they will require to be reckoned with both in the present and future of India. Their strength is already great, and their possibilities are greater. It may assist the Australian to realise them, if it be remarked that, varying in size from a small shire to a considerable kingdom, their joint area is greater than that of Queensland, their revenues nearly as large as that of the continental colonies, and their population 20 times as large as that of Australasia. They have their own kings, courts, and armies. These are in some instances animated by a patriotic spirit which guards their autonomy with eager and jealous zeal.

It would be a tedious and, in this connection, an unnecessary task to catalogue the independent States of India. The chief is Hyderabad, exactly the size of Victoria, with a population of 10,000,000 and a revenue of about £3,250,000. Kashmir, with the same area, has a population of only 1,500,000, and a revenue of £750,000. Gwalior, with its 29,000 square miles, carries over 3,000,000 people, and gives a revenue of £1,500,000, while Mysore, with 24,703 square miles, maintains 4,250,000 people. Independence is preserved, in Gujarat and Rajputana, to hundreds of petty chiefs, who are rulers

over principalities about the size of a Colonial sheep-run. Nor is it essential to detail the particular characteristics of these political entities, for they are infinitely various. So is the degree of authority which they enjoy; a factor determined by the character of the ruler, and the barbarism of his people. The proper term by which to refer to the whole of these would be "dependent States," for although they are left very much to themselves in domestic affairs, so long as they abstain from wholesale massacre and plunder, they are not permitted to have a foreign policy, or take any step that might endanger British supremacy.

During the minority of a native prince, the British Government often takes temporary control of his principality, though this is occasionally placed in the hands of a council of relatives or nobles. As is natural, native chiefs govern by native methods, and consequently much transpires which jars European susceptibilities. If a perfectly free hand were allowed in these dominions, the rest of India, so far as it is educated and interested, would soon receive a lively lesson in the relative merits of white or brown management. The titular ruler, however, being under considerable moral constraint, the result is what may be termed a whitey-brown policy. which serves as a modified contrast to the *régime* under English control. There is very indifferent justice in the public tribunals, a great deal of corruption in the courts, an oppressive taxation in many districts, favouritism in all appointments, and a sublime disregard of material progress, sanitary conditions, and anything approaching to constitutional government or political liberty. Every native court has its British resident or political agent, who, keeping himself acquainted with all that occurs, exercises a quiet but effective influence upon the general action of the Government in public affairs. He does not meddle with private grievances unless they are very exceptional. Of course there are recalcitrant princes who make a struggle against such interference, while there are others so docile or weak as to be reduced to little more than puppets in the hand of the agent. In many cases the real power of the State rests with an astute vizier or knot of notables, and it is with these, and not with the nominal chief, that the British representative has to deal.

Advantage is taken of every opportunity to mould the States into the same political shape as is assumed by British territory. Indian and Imperial titles and favours are showered upon chiefs who conform to a European policy, or who introduce reforms of old abuses. By these and similar inducements progress has been effected in some States, though it has been accomplished in the name of men who have little real sympathy with the onward movement in which they were induced to take part. It is not surprising, therefore, if the actual working of institutions introduced with such motives, and by such means, should not always answer expectations. The heart of the chief is not really with reform, and the hearts and minds of the whole of his dependants and Ministers is always entirely against them. The difficulty of

working European political and social machinery by native aid cripples even British administration, and hence it is not surprising that the native States remain at best a feeble copy of its outside. The native ideal is nothing like the Caucasian, and the native method is antagonistic in the same degree. One of Kipling's poems tells how

Rustum Beg, of Kolozai, a slightly backward native state,
Lusted for a C.S.I.—so began to sanitate.
Built a gaol and hospital—nearly built a city drain,
Till his faithful subjects all thought their ruler was insane.
Who, when instead of obtaining the equivalent of the colonial C.M.G., he was only given a C.I.E.,
Straightway disendowed the gaol—stopped at once the city drain:
Turned to beauty fair and frail—got his senses back again;
Doubled taxes, cesses, all—cleared away each new built *thana*:
Turned the two lakh hospital into a superb *zenana*.

And of such a type are most of the native princes of India.

The paternal solicitude of the Viceroy and his advisers renders them invariably a little blind to the faults, and very kind to the virtues, of their protégés. Their official report, made annually to the House of Commons, softens reproof as far as possible, but is often compelled to utter accents of regretful condemnation. In 1890 Hyderabad was noted for the increase of its crime record, the difficulty of obtaining convictions of armed robbers, and the uncontrollable character of its irregular troops. His Highness the Nizam, like most Indian potentates, absorbs large sums for his private purposes—more than is devoted to education, law, justice, and public works, in the whole of his dominions, and spends more than half as much again upon what he is pleased to call his "army." Mysore is only just recovering from the last famine, which cost its Treasury £2,400,000 and the lives of 1,000,000 people. In Baroda civil and criminal cases are alarmingly on the increase. In Kashmir the maharajah has been replaced by a council, because of his misrule. "Under the system of assessment in force the cultivator has been pressed down by the unchecked greed of the official classes to the condition of a coolie cultivating the State property on a bare subsistence allowance, and the artisan classes have shared in the general ruin." It is to such a minimum of the coarsest necessaries of life for the masses that native rule almost inevitably tends.

When as at Indore under British influence there has been an effort to relieve the peasants, the Government remission is so manipulated that its profits flow into the pockets of revenue farmers instead of the peasants. "No accounts of revenue or expenditure are submitted," from Hill Tipperah, "but it is known that the maharajah is in debt. It is believed that the embarrassments have been increasing, and his Zamindar property in British territory is known to be mismanaged." In Khairpur "the administration of justice is summary. The State is in debt, but accurate information respecting the finances is not available. Trade is

hampered by numerous and vexatious imposts." And so the record runs, including in one State a religious riot in which the police have taken sides. In the attempt to compress the facts as to native States the writers of the Blue Book have unconsciously developed a kind of humour. Thus it is remarked of Thal Chotali that "trade has largely developed, litigation is much more frequent, and the inhabitants of the country give evidence of having entered upon an era of prosperity." Again, the public are told that "the young maharajah of Patiala was married in November, 1888, and after the close of the year under review was invested with full governing powers." Whether this is intended to awaken sympathy for his condition during the interval, how the Viceroy has managed to disturb the balance of marital power, and what full governing power in the Zenana may mean, are interrogatories which nothing in the statistics enables the interested reader to divine.

Confessions like these convey an idea of the administration of the native States which is not to be derived from eloquent books written by such enthusiasts as Sir E. Arnold. To conceal the barbaric conditions of the peoples, or the fact that this barbarism always means injustice, oppression, extravagance, and corruption, is not the best plan of educating the British public. The plain facts of the Blue Book are infinitely more valuable, or such studies as those of Sir Alfred Lyall, who puts his life's experience in Rajputana into one or two chapters. Those who wish to grasp the true political and religious condition of the people, past and present, must turn to his "Asiatic Questions." Even a condensation of that most pithy book is impossible save upon one point. English writers, from Burke and Macaulay downwards, have employed the names begotten by European history, institutions, and functions, to express their Indian experience, and impress it more vividly upon their readers. By this means an absolutely erroneous series of ideas has obtained currency. India has been regarded as an Asiatic Europe, composed of States with definite boundaries, with reigning families, orders of nobility, and established forms of government. It would be scarcely too much to say that the language might have been applied with little more impropriety to the Sioux or the Zulus—not that these tribes can be measured with the higher caste Hindus, but that the machinery of western national life and its terminology are utterly inapplicable to both races, and both stages of civilisation. The condition of things in India has to be conceived as fluid, not mixed. Prior to the advent of Europeans succession to the throne was obtained only after a process of natural selection by battle; nobility in the Mughal empire there was none; the rights and privileges of classes and orders, which British law has stereotyped, were capable of radical alteration under many contingencies. There were, and are, tribes and clans, but no nationalities. Practically there were, and are, no native institutions, that could be fitted into a European system of life and thought, without altogether changing their spirit and form. Indian civilisation to-day is imperfect, arrested, and incongruous, and always has

been. The history of the conquest requires to be written anew in view of these facts, because until this instability and flux are fully recognised, justice cannot be done to Clive, Hastings, and the great founders of the empire. Those who doubt need but to acquaint themselves with the real status and quality of the independent principalities to-day, after years of patient guidance, with trained counsellors at hand to advise, and with models to instruct them daily before their eyes.

Jaipur is the show State, and its capital the show city of Rajputana, of the independent territories, and in a sense of modern India as well, so that it may be taken as the best possible illustration of what a native government can achieve, when possessing a capable head imbued with European ideas, ambitious of distinction, and under the assistance of highly trained European officials, whose hearts are in their work. Those who desire to dwell upon its picturesque aspects will find them charmingly described in "India Revisited." The captious might object that if Jaipur is appropriately referred to by the same author in the P. and O. handbook as "a rose-red city half as old as time" the accepted chronology will need much abbreviation, since as a matter of fact its foundations were not laid until 1728. The native portion of the unimproved city has the same antique appearance as all other Hindu towns, whose flimsy materials, always neglected, are soon dilapidated, and whose fine edifices for the same reason take on a worn and ancient outside at a very early date. The walls, 20 feet high, with bastions and towers at intervals, are in a state of good preservation, presenting an imposing appearance from all points of approach. Entering the gates one finds several spacious streets driven right through the town, at right angles to each other, lined on both sides by two-storied buildings, varied regularly with those of three stories, and irregularly with higher edifices. All of these are stuccoed, washed with the same shade of pink, and lead to spacious squares at their intersection, where innumerable pigeons congregate, and the human concourse centres. High bare hills, fort crowned, surmount and almost surround the town, over which they mount guard, looking down upon a graceful towering palace, and spacious gardens in the centre.

The marked characteristics of garb and demeanour among its people add to the picture. Whether the Rajputs are actually of Scythic or Aryan descent, they represent the freer, bolder, and more patriotic native tribes. As Sir James Mackintosh wrote, they are "the representatives of Hinduism. In them are seen all the qualities of the Hindu race unmitigated by foreign mixture, exerted with their original energy, and displayed in the strongest light." They combine "unconquerable adherence to native opinions and usages, with servile submission to any foreign yoke: an unbelieving priesthood ready to suffer martyrdom for the most petty observance of their professed faith; a superstition which inspires the resolution to inflict, or to suffer, the most atrocious barbarities, without cultivating any natural sentiment or enforcing any social

duty." Attachments without friendship or patriotism, good temper and ferocity, timidity and heroic valour, are united in them, not in such violent contrasts as these rhetorical periods might lead one to suppose, but all of them displayed by some members of this mixed race, which is assuredly the most daring and dashing of the peoples of India, excepting the Sikhs and the Goorkhas.

The Rajputs are knitted together by ties of blood similar to those of the Highland clans, and of fealty akin to the feudal order. Excellent horsemen, adorning their sturdy ponies with gay trappings, armed at all times, and often with long spears, they have the dashing carriage of free lances who are accustomed to demand rather than pay toll. Their chiefs glitter in velvet and jewels, riding upon brightly-caparisoned steeds, among groups of followers and running footmen, who wait upon their will. Even the traders of Jaipur, renowned for their business energy and skill, have a half martial air and bold dark eyes. The peasant is much the same everywhere, and such of the women as are seen, except, perhaps, that they are a little taller than in the south, are not remarkable. The splendid palace, buried in extensive gardens, the spacious public ways, and graceful buildings, enclosed within the city walls. to which great gates give entrance, under towering cliffs, with climbing fortwall and turreted stronghold above, express the feudal power and dignity of the Indian native State.

It is perhaps not advisable to lift the curtain too high, or scan the *mise en scène* too closely, and yet candour requires that the thing in itself as it really is should be truthfully portrayed, even at the risk of spoiling a pretty picture. Splendour and squalor are always associated in Europe as well as in India, but in Asia, including Jaipur, more closely mixed everywhere. The whole city is the creation of a despot, and not a free growth of its civic life. The broad streets are therefore encroached upon, and its squares more or less filled with pedlers and their wares, scattered over the pavement and into the roadway--one part of the footwalk is enclosed for a wedding breakfast, partaken of *al fresco*. Uniformity in the streets is obtained by the erection of a false façade, for along a great part of them the second story does not exist. The pinkish hue is simply a wash laid upon the mortar. It is only the outside of the plaster that is gorgeous, for the by-ways and lanes are as tortuous, narrow, unkempt, and disorderly, as in most other eastern towns. The people are as heavily taxed, and but little more enlightened than the average. Much of the modern palace is tawdry and tasteless in its interior decoration, and there is everywhere a too patent attempt to impose a veneer of civilisation and art upon the realities of native life. Jaipur has been termed a bride-cake city, because its pink walls are picked out with white sugary looking ornamentation, and it might be termed a birdcage city, because of its style of architecture, but taking into account its numerous feathered populace and characteristic hedges, it is perhaps best described as a city of pigeons, peacocks, and prickly pears.

What acclimatisation has done was illustrated forcibly by the emu and kangaroo in the Zoological Gardens close by the palace, far from their home and freedom, prisoned to help a Hindu holiday. No picture of India is complete which does not dwell upon the exuberance of animal life. As Sir Monier Williams writes: "Mosquitoes will settle affectionately and fearlessly on the hands of most recent comers, leeches will insinuate themselves lovingly between the interstices of his lower garments, parrots will peer inquisitively from the eaves of his bedroom into the mysteries of his toilet, crows will carry off impudently anything portable that takes their fancy on his dressing-table, sparrows will hop about impertinently and take the bread off his table-cloth, bats will career triumphantly round his head as he reads by the light of his duplex lamp, monkeys will domesticate themselves jauntily on his roof, and at certain seasons snakes will domicile themselves unpleasantly in his cast-off garments, while a whole tribe of feathered creatures will build their nests confidingly under the trees of his garden. . . . I looked down . . . on a tract of country swarming with tigers and wild animals of all kinds . . . on the increase in these and other similar localities." ("Modern India," p. 185.) In this respect Jaipur is certainly not behind any of its rivals. Splendid specimens of the rhinoceri and the tiger are caged, while elephants and falcons are met abroad familiarly in by-ways. Buffaloes and white draught oxen, with long horns, fill the streets, monkeys leap along the parapets, cheetahs sit chained, watching with unwinking eyes, and ever ready for sport, and long lines of camels wind out of the gates, taking their way across the extensive and arid plains, on which are dotted the hamlets of Rajputana.

But it is not a modern city, built to order in imitation of an European metropolis, that can convey a conception of the bold, fierce, predatory Rajput life. For that one must journey a few miles, mounting an elephant, whose swinging gait slowly climbs a paved ridge in the long, bare hills, whose sudden acclivities are crested by a sinuous line of fortification, taking advantage of every crag and comb to throw its armed embrace around the valley beyond. Here a thousand years since stood a fort of the Meenas, which was taken by storm seven or eight centuries ago by Man Singh, founder of the City of Amber, so called after one of the names of Siva the Destroyer and Reproducer. There still stands the palace that he built, and in which he lived with some of his 1,500 wives, of whom 60 went to the funeral pyre in honour of his death. The grim gateway on the rocky summit seems a fit entrance to a place of gloomy memories. A road winds down the far side of the hill to the ruins of the conqueror's city, deserted 160 years ago, when, according to the legend, his successors became ambitious of commercial expansion, and felt the mountain stronghold too confined. Cramped it was, as Herculaneum was cramped, but for the better reason—that of defence. The buildings are squeezed together between and upon the steep rocky ribs of a narrow valley, divided into two parts by a sharp cliff wedge at the higher end, from which the palace over-

looks the whole, the two minor gorges opening at its foot into a somewhat wider curve where the main town lay packed, right in the open jaws of the range. Looking across wall and battlement one beholds beyond, the wide open plain into which the proudly panoplied band of audacious Rajput brigands sallied after wandering caravans, or returned from the sack of surprised cities on the south and east. All are departed now, and neither trade nor adventure house in this human eyrie. The marts and dwellings fallen to decay, the shattered hill-side temples, and roofless cots where the poorer dwelt, still surrounded by strong lines of bastion and parapet, might furnish an appropriate abode for De Quincey's Lady of Sighs, who appears only "in solitary places that are desolate as she is desolate, and in ruined cities, when the sun has gone down to his rest."

Above the whole, where Greeks would have built an acropolis, and Romans a capitol, the Hindu despot built himself a palace and a zenana whose wild and savage grandeur realises those dreams of Gustave Doré, in which an ancient castle pinnacles itself upon the edge of a precipice, and runs along the height of a range, its clinging and crenellated masonry topped with towers, that from their airy height look down into the depths of a dark lake mirroring their sombre might in its weird waters. Ascend the shingly path, and you enter by a splendid portal a yellow-and-white fortress, which rivals the Tower of London in extent, and contains what is declared to be one of the finest gateways in the world. The great court-yard of red and white stone, formerly thronged by a train of servants and retainers, has now but a few peons retained for its protection. One is training partridges to fight, another mournfully blowing into a native flute. Upon the first flat roof of the nearest and lowest building is an exquisitely beautiful hall of audience, open on three sides, supported by sandstone and marble pillars magnificently carved and richly roofed. From here, sitting in state, looked upon by his ladies through a lattice, the majestic and bejewelled Rajah, turning his glances from those who came to do him homage, to crave alliance or to sue for peace, looked down upon his busy city at his feet, and over it, and away beyond Ramgarh and the Banganga River, to the far horizon, vague, as the future of an ambitious man.

He might wander within from hall to hall of luxury, marble bath-rooms, and day rooms bright with mica and dazzling chunam, through ivory doors, to a garden hidden in the heart of it, where, between stone walls and paved paths, sprung fruits and flowers in tangled greenery. Here a fountain leaped in the noonday sun or in the evening shadows, when out of the dark little cells in which they slept the beauties of the harem came forth to breathe the fresh air or to rest in the lamplit chamber, down one of whose sides a cool stream plashed, flowing brightly in its marble channel along the dainty floor. Doves coo still in its silence as in the days when this was a monarch's retreat. Otherwise, the booted tread of the stranger alone awakes its echoes. Rude red frescoes on the inner

walls, with plentiful absence of perspective, depict with a formality which forbids accuracy, some of the sacred cities of the Hindus, only known to the women sheltered here by such rude and half-mythical representations. And now Amber itself is little more than a fresco. "The sleeping and the dead are but as pictures." The palace sleeps and lives, the city is dead and given over to decay. Alligators float at peace in the lake below, and the eye of the eagle above sees but a few score recluses or fakirs smeared with ashes, moving amid the weedy ways of the silent city. A fortress without a guard, its long walls enclosing nothing; its mouldering houses lead to the sombre and solemn pile, a palace within, a keep without, visited once a year at the feast of Dasahra, when hundreds of buffaloes and scores of goats are butchered before the shrine of Durga, the bloodthirsty wife of the god after whom the town was named, whose loneliness and ruin render it the fitting scene for such hideous slaughter.

CHAPTER IX.

THE NORTH-WEST PROVINCES AND THE PANJAB.

The North-west Provinces are so called because of their geographical position in regard to Bengal proper and its capital, Calcutta. They commence in the south where the Ganges makes its great bend at Patna, and embrace the immense alluvial plain, larger than the whole of Victoria, lying between the Jumna and the Himalayas, extending on the north nearly to Simla, and bounded on the north-west by the Panjab. The imperial city of Delhi is separated from them only by the river, while they include within their boundaries the historic centres, Benares, Allahabad, Agra, Lucknow, and Cawnpore. The two first are the most sacred shrines of Brahmanism and its modern form, Hinduism; Agra and Delhi were the capitals of the Mughal empire in the periods of its greatest splendour, while the last names in the list are indissolubly associated with the bloodiest episodes of the mutiny. The province practically embraces the holy land of Buddhism, and the scenes of the oldest and greatest national epic; it contains the most gorgeous remains of Hindu Saracenic art and memorials of Muhammadan supremacy; almost as densely peopled as Bengal, it unites with that province to form the most fertile, productive, and wealthy portion of India; favoured in ordinary years with a sufficient rainfall and admirably supplied with wells, it possesses the oldest and most important of modern canals. It is therefore in every aspect the most notable of all the provinces, overshadowed only in the earliest and latest times by its neighbour, the Panjab.

As incidentally its history, its chief cities and their edifices have been already touched upon, it is unnecessary to make further reference to it here. Physically it is one with the Panjab, forming a whole of which the best-watered and most densely-peopled half lies east of the Jumna.

The last of the great divisions of India, lying west of that river, is the size of New Zealand, or less than a fourth larger than Victoria. It stretches from Delhi and the Jumna on the east, along the roots of the Himalayas, and borders of Kashmir on the north, to Afghanistan on the west, its southern boundary curving around Rajputana to Sind, where the Indus distributes its mighty floods along an extensive delta, which beyond its influence is sandy and barren, but rich and fruitful within the range of its waters.

The name of the Panjab (five rivers) is derived from the four great tributaries, the Sutlej, Ravi, Chenab, and Jhelum, which, with the Indus, water this portion of the great plain of northern India, rendering it highly productive, while the independent States to the southward are arid, sparsely peopled, and rarely fertile. Rajputana, with 129,750 square miles, contains but 10,000,000 people, while the Panjab, in its 106,000 square miles, includes nearly twice as many. With a lighter soil, smaller rainfall, and better drainage than the North-west Provinces, the Panjab has a much more limited underground water supply, and hence the wells, which play so large a part and maintain so dense a population in the Ganges valley, are a much smaller factor. Hence also, the Panjab canals, which in size, cost, and mileage already equal those of the Upper Ganges, occupy relatively a more important place in its economy, the dependence upon the rivers and their visible flow being exceptionally obvious in the valley of the Indus, where other supplies are small. The two districts—one occupying for western India the same place as the other does for the east—are correlative and complementary. The delta of Sind, politically attached to the Bombay Presidency, cannot be compared for one moment in size or wealth to that of Bengal, but the Panjab may be appropriately contrasted with the ancient states of Delhi, Oudh, and Rohilkand, with whom its political fortunes have generally been allied, and with whom it divides the honours of history. Differing in soil and water supply, these provinces differ also in climate. The fiercest heat in India is found along the north-western border, where a temperature of 117 degrees in the shade is succeeded a few months later by bleak and biting winds, and on the hills by occasional falls of snow. The summer is more intense, but shorter than to the south or east, while the winter is much colder; the extremes are greater than those of Australia, the heat in its persistency and oppressiveness exceeding that of Cooktown, while its winters are as cool as those of Sydney. We encounter here the products of the Australian spring and early summer, grown in an Indian winter, almost as cloudless and almost as warm.

The Panjab is a great plain, but it lies immediately at the roots of the mountains, and runs up into the angle at which the Himalayas are joined by the subordinate ranges running southward to the sea. Its people have preserved the mountain hardiness, boldness, cheeriness and spirit to a greater degree than their neighbours on the east. Moreover, as the passes which give access to the whole peninsula lie in this corner, the province has become the thoroughfare by which traveller, merchant, and invader, have made their way, and the name of the entire country has therefore been derived from that of the Indus. The fruitfulness of the well-watered plains of the Panjab has tempted many strange chieftains to stay, and thus it has become the centre of powerful empires. The sun of victory over India has risen in this north-west for the past 3,000 years. The faces of its new conquerors set southward have been discerned there age after age, for the earliest histories reveal

them, only when emerging from the Central Asian sphere of darkness, they meet the morning on the Hindu Kush. There has been but one exception to this rule, and this was furnished by the seaborne Europeans who took the country in the rear, meeting and conquering its rich and enervating sea coasts and its most pusillanimous peoples. The several races of the north-west, at first its invaders, have afterwards become the guardians of the country, and have held back by their valour as long as possible the later hordes, who have followed in their footsteps.

Out of primeval darkness emerge the light-skinned hosts, debouching upon the Panjab from some part of the high table-land beyond, whence it is conjectured that the ancestors of the Caucasian races had their origin. There had probably been earlier influxes of other peoples in still remoter times, but of these no testimony remains, and the first of the invading hosts known to us is composed of the high-spirited, generous, warlike, and intellectual Aryans, with whom, not without pride, we claim kinship. Nomadic in habit, they were passing from the pastoral to the agricultural stage as they slowly distributed themselves over the northern plains. The highest evidence of their mental development is afforded by the Vedas, in which their poets praised their gods in a language which for flexibility, copiousness, grace, and power, still disputes the supremacy with ancient Greek, and the best of modern tongues. Polytheists, they yet had glimpses of the greater revelation of the Heaven-Father, "the one King of the breathing and awakening world. He who governs all, man and beast. . . . He who gives life, He who gives strength; whose command all the bright gods revere; whose shadow is immortality, whose shadow is death." They preferred their requests to their deities with childlike directness, incidentally sketching the outlines of the country in which they then lived. "The Indus exceeds all the other wandering rivers by her strength. . . . To thee, O Indus, they come as lowing mother cows to their young with their milk. Like a king in battle thou leadest the two wings when thou reachest the front of these down-rushing rivers."—(Reg-Veda, X. 75.) "May the Indus, the far-famed giver of wealth, hear us; (fertilising our) broad fields with water," from which it seems that even at that time its inundations were utilised, though probably chiefly for pasture, since they sing to Indra, "Thou hast broken open the rain prisons, rich in cattle. . . . like calves to cows, so do the waters hasten to the sea." At that time it is thought that the country was much more marshy than at present, and it has been by means of the deeper channels, which the rivers have cut for themselves, that swamps and lagoons have been drained off, while the deposit has built up the coast to the south, so as to leave ancient seaports far inland. The Aryans of that age, who conquered in time the Ganges valley as well, possessed none of the stringent caste limitations, or grosser superstitions, which compose modern Hinduism. Their women were treated on terms of greater equality, the father of the family was priest in his own household, and they regarded the Invisible generally with a manly confidence

and reasonableness of judgment, very different from the attitude of their degenerate descendants towards their depraved deities. The history of India is an evolution in which periods of decay and decline are common, and in which the cycle of the ages discovers no substantial or universal advance.

Being the last great addition made to British territory, if the recent annexation of Burmah is left out of account, the Panjab has been exceptionally fortunate. It has been from the first organised and administered in the light of previous experience, and by the most approved methods. The simplicity of Sikh rule left a way open to reform, of which the men whom Dalhousie put in power were not slow to take advantage. The Lawrences and Mansel were the first triumvirate, and when Henry Lawrence's gentleness threatened to become an obstacle, his sterner brother John was given supreme control. The transformation effected in a few years with the aid of Herbert Edwardes, Nicholson, Montgomery, and a splendid band of picked associates was almost incredible, for while crime, brigandage, and oppression, were stamped out, roads, bridges, and canals were multiplied, and yet the taxes lowered in their incidence. There has been an equal good fortune in the construction and control of the irrigation system, which has been developed in the light of experience gained elsewhere, especially upon the great canals of the contiguous Doab, and officered by some of the most brilliant engineers in the Indian service. It would be strange indeed if under these circumstances the Panjab did not exhibit the British raj in one of its best aspects, especially as by means of railways, and the opening of the port of Karachi, its producers have been enabled to build up a large export trade. The present Governor, Sir James Lyall—emulating his brother Alfred, the poet and philosophic statesman, whose reign in the north-west is affectionately remembered—is proving an admirable administrator of the "model province" of India.

Lahore, the capital, consists of three parts—city, suburbs, and cantonment. The native city is of immense antiquity so far as site is concerned, has been many times a seat of empire, was famous enough in the days of the old Commonwealth to be mentioned by Milton, and even to-day is walled and gated as when it was the chief seat of Ranjit Singh. Its narrow, winding, ill-kept streets, without footpaths, are scarcely wide enough for one vehicle to pass. Its two and three-storied brick buildings—low, contracted, and box-like—are hustled together about blind twisted alleys, which, with their courtyards, present blank wall-faces of yellow and white plaster, to the prying outside world. The Muhammadan anxiety for privacy imparts, even to its dwellings, a sullen air of suspicion and resentment of any attempt to penetrate the seclusion of its feminine and domestic life. Its shops are small but busy; its mixed populace, reinforced by Pathans and Kashmiris, holding horse fairs and markets just outside the ramparts, crowds into narrow spaces, where 150,000 people swarm like bees in a beehive or ants on an ant-hill, with sublime disregard of all

European principles of sanitation, and ideas of convenience. The enjoyment of freedom of movement or fresh air is apparently unconceived, if not inconceivable, to them. The home is usually a den, in which the women live, but from which the men make their exit as much as possible into the open air, where indeed the poorer classes of both sexes spend most of their lives, retaining one or two small cells in a dark dwelling, up an undrained right of way, where they can eat, sleep, and multiply.

Beyond the walls stretches the European quarter, covering an area many times as large as the city, to accommodate a few score whites in spacious bungalows. Each of these, without regard to size or function, whether private residence, bank, shop, or merchant's office, stands in its own compound or garden, in villa-like seclusion, away from the road. In its park-like extent and openness, this part of Lahore resembles Madras or Poona, the distinction being that the vegetation is not tropical, as in the former, while the buildings are smaller, and are distinguished by the possession of chimneys. The park is exceptionally fine, and the fort and mosque beyond it worthy of being named with those of Delhi and Agra, are of a kindred historic interest. Six miles from the city is the Mian Mir Cantonment, where some thousands of troops are concentrated, as usual out of sight, but within effective striking distance. Everywhere under the velvet paw of the civil establishment in India one finds the sharp claws of the military ready for all emergencies. The authorities appeal to the interests of the people, and spare no pains to render their rule acceptable to them by reason and justice. The missionary preaches where he will, the schoolmaster teaches all whom he can persuade to listen, and the Government blandly maintains the fiction of self-government wherever possible, but none the less consistently sees that, close at hand, its soldiers are ready at an hour's notice, with their ammunition in order, and their bayonets keen and bright.

The familiar circumstances of Indian life, its contrasts and confusion, are in no way lessened even in this Ultima Thule of the peninsula. A more bracing climate, a wilder aspect of nature on its borders, more important foreign relations, bolder peoples, and its more recent annexation, have combined to lend to the Panjab a greater interest than that attaching to the older provinces. But though the manlier nature of the people has counted for a good deal in its rapid development, it must not be inferred on that account that its population escapes from the categories which embrace the whole country. There is, perhaps, a greater variety of race and more palpably contrasted types than in the rest of Bengal, but certainly not more than in the south. Kashmerians and Pathans are as frequently seen here as are Nepalese and Bhutias in the eastern districts, as they go pushing their way in pious pilgrimages to Benares, or Allahabad, where their long dark hair, large staring eyes, broad muscular frames, and thick heavy clothing make them conspicuous among the crowds of sleeker skin, lighter physique and shaven cleanliness. Among visitors to the Panjab, some of

the Kashmerians bear most resemblance to these yellow Mongolian peoples, the Jew-like Pathans from beyond the Hindu Kush being fiercer, keener, and more energetic. The Sikhs, themselves a war-like race, dashing in appearance, are less wolfish than the wild tribesman of the frontier, who hates the placidity and order of civilised life as much as he despises the feebler peoples of the plain, vowing with the old Pindaree—

> If I were forty years younger, with my life before me to choose,
> I wouldn't be lectured by Kafirs, or bullied by fat Hindus;
> But I'd go to some far-off country, where Musalmans still are men,
> Or take to the jungle, like Cheetoo, and die in the tiger's den.

The Brahmans of the Panjab are less than 1,000,000 in number, while the Rajputs are considerably more than 500,000; the Sikhs stand first if reckoned as a caste, but they are only a seventh of the whole body of 7,000,000 Hindus in the province, and these again are outnumbered by the Muhammadans, who muster over 10,000,000, or more than half of the total number of inhabitants. They are the most backward of all in education, only one in seventy being able to read and write, as against one in seventeen amongst the Hindus proper, and one in twenty-four among the Sikhs. There is in the Panjab the same substratum of pre-Aryan tribes as elsewhere, upon whom have been imposed successive layers of Aryan, Scythic, Turkoman, and Afghan invaders. Across the religious and ethic divisions came those of occupation. The Jats, Scythic in origin, are most of them Hindus, though some are Muhammadans, but all are agriculturists; a fine stalwart race, whose women work in the fields, and who exhibit a tincture of democratic independence and individuality in their behaviour. The Rajputs—most of whom descend from an allied stock—are braver and more quarrelsome, support their chiefs with feudal fealty, and prefer pastoral pursuits, mixed with reaving, to ordinary farming. The Sikh's make excellent so diers and good cultivators, thus uniting the qualities of the other two classes, their bond of union being religious. The Brahmans, when they go upon the land, as the Tagas have done, are bad farmers, and as a rule prefer quiet or civic occupation; they enjoy the reputation of being bad neighbours. They have grades of their own in an ascending hierarchy, but invariably preserve a haughty and insolent attitude to all outside their caste.

There are other main tribes, such as the Rors, who approach closely to the Jats, the Gujars, notorious for thieving and lying, with numerous miscellaneous and menial castes whose peculiarities it would be tedious to recapitulate, as all of them have practices, rituals, and deities of their own. Caste rules compel them always to intermarry within bounds, but at the same time there are elaborate provisions against the union of relations, so that no man can marry a girl from his own or even immediately adjoining villages, or who is related to the family of his mother, or his father's mother. Such prohibitions vary much among the castes, as do their habits of intercourse. Muhammadans are becoming indifferent

to companionship at meals, though they often recognise restrictions, which among the Hindus prevent eating or drinking between those of different castes. Some castes are of doubtful, some of absolute, impurity in the eyes of others. In addition to these divisions by blood, belief, and association, there are feuds of an hereditary character bred in ancient strife, which still separate village from village, so that they will not unite for any purpose. Irrigation officers are at times compelled, on this account only, to put them in distinct canal districts. From such relics of custom as these one arrives at a clearer conception of what the whole country was when rent with intestine discords, race against race, creed against creed, class against class, and village against village, and of the difficulties with which the remnants of these strifes and caste antagonisms, when added to the innumerable prejudices still in activo operation, surround the task of administration.

An instance of what may be accomplished is to be found on the very threshold of the province. The fierce Afridi, or implacable Ghilzai, who reins his steed to-day as he enters the Peshawur valley, mountain-circled, and seamed with gullies, that cut their way abruptly through an irregular arid plain, in which the Swat joins the Kabul river, hurrying eastward to the Indus, witnesses a remarkable testimony to the wealth-giving properties of water. He has come through the 33 miles of the Khyber Pass, between mountains rising to 7,000 feet in height, under the guns of the fort of Jamrud, and within sight of the city of Peshawur. The houses of its 80,000 people, surrounded by a sixteen-gated mud wall, and a chain of ruined watch-towers, are overlooked by the bastioned and powerfully-armed Bala Hissar, where floats the Union Jack. A ring of snow-clad summits surrounds the whole valley; its uplands for the most part stony wastes, its lowlands sand and shingle. But what the visitor will most marvel at is its belt of grateful verdure. The suburbs of the town are filled with orchards of peaches, apples, quinces, and pomegranates; there are fertile fields in the flats along the river, and the villages which lie near them reap harvests from the level stretches commanded by inundation channels. To these have now been added a permanently-irrigated area of splendid fruitfulness, under the Swat canal. Despite its situation, the rough country to be covered, the obstacles to be surmounted, the apparently untamable nature of the population, and their lawless habits, this scheme has accomplished in the Peshawur valley a great economic and social reform, has established a guarantee of peace, laying the foundation for a moral reform, which the wisest of Indian statesmen recognise as the only sure foundation for good government, whether that government be in European or in Hindu hands.

The first conception of the scheme belongs to Sir Henry Lawrence, whose motives were those of the statesman rather than the financier or engineer. It was of the first importance to establish a permanent agricultural settlement which would link the people of the place to their lands, furnishing a standing advertisement of peace, and an object-lesson of prosperity to the unruly and quarrelsome

clans beyond. The fruitful security provided and guaranteed by the British Government in this outlying patch of wild border must impress Pathans, whose only conception of civilisation is derived from a frontier town, or a fairing visit, coming, as they say—

From a country hard and barren to a softly-watered land,
To a round sky line of harvest from a wilderness of sand;
From our bare and barren homesteads, from our feast of dates and milk,
To your palaces, your flesh-pots and your raiments of the silk;
From a land of fenced citadels, where blood is lightly shed,
Where a clan must hold its borders and a man must keep his head;
Where the wayfarer benighted, as he nears a village late
Spies the red spark from the matches of the guard about the gate.

The same lesson is repeated everywhere, for everywhere the white Government has studied its subjects. If any invader in the future shall ever force the passes to the north-west, and enter India on the trail of the conquerors of the past, his soldiers will find the province at a higher pitch of material prosperity than it has ever enjoyed in historic periods. Like the heroic though ragged, Republican soldiery who followed the star of Napoleon, when it first rose upon the world's horizon above the summits of the Alps, they will look down upon a territory whose extreme fertility, like that of the valley of the Po, is almost wholly derived from irrigation. Hindustan proper, in its vast extent, contains not only that part of the Panjab which might be entitled the Italy of the East, but also a France, a Spain, and a Turkey as well, more populous and agriculturally more productive. In the west a further resemblance to Piedmont and Lombardy may be traced in the valiant character of its peoples, as also in the fact that the province has been a battle-ground for centuries. In this it is not unique. Asia as a whole is still far from the industrial stage; the sword must be its arbiter for many a day; the British suzerainty is threatened east and west, and probably generations will pass before it can be said that the Indian empire is peace.

So far as peace reigns it is the creation of British rule. It would take little, were its regiments withdrawn, to precipitate the still, divided country into fierce struggles among several States and races. What the soldier begins the irrigation engineer continues. The once bellicose Sikhs, among whom, less than fifty years ago, every man was a warrior, have become so attached to the soil since the opening of the canals, that they no longer furnish even a sufficiency of recruits for the native regiments. This transformation of the country and its people has not been accomplished without sacrifice of life, even among the non-combatant officials. Many a fine young Englishman has succumbed to the fierce climate and privations of pioneering work in the field, in order that the ryots might not starve. The resting places of their fever-wasted frames, are marked, in quiet out-of-the-way corners, by a simple headstone, and notified perhaps by a line in the official gazette.

This is their reward—their only visible reward—when they have

laid down their lives for aliens, spent in a terrible struggle against an unsparing climate for inappreciative, half-savage tribes.

The old chiefs of the country took another view of their obligations, and of posterity's indebtedness to them. They built no canals or bridges in these tracts, but only lines of forts such as I have seen beside the Sirhind canal. Walled, moated, bastioned, and watch-towered, stand they still, grey and grim, in the pleasant sunlight, where now, from ridge to ridge between them, the fenceless harvest spreads across the plains, small pillars, or heaps of stones, indicating in the old biblical fashion, the boundaries of the several holdings. A pair of eagles in a cloudless air, a shepherd with his flock, and a goatherd chasing an unruly kid were the only living figures in the scene. The shouts of an issuing foray, the glittering bands of caparisoned horsemen with their train of booty, trampling eagerly across the fords, the night attack of reprisal and revenge, are now almost forgotten even in these border lands. A company of native troops camped a score of miles away, under the command of a single white officer, now represents the military force of an entire district.

When his career of rapine was over, and the Rajah was gathered to his fathers, he took care that his memorial was reared in a style and upon a scale befitting his sense of self-importance. Among clumps of trees are some half-dozen tombs, such as lie out of and around Lahore, Delhi, and Agra, fortress-like in the strength and solidity of their weighty walls, rounded in shape, two or three storied, with arched portals and windows of the old Roman style. The spectacle of dozens of those erected by their predecessors hastening to decay, does not appear to have damped the architectural ardour of their builders, or to have dissuaded them from that vain old fight against death and forgetfulness, which has been waged in so many capital cities now obliterated, in so many cemeteries now built upon or under the plough, and which, even in the magnificent memorials of Egypt, becomes but a hollow and idle mockery of mortality, and its trivial pride. Yet they have a message to the Hindu if he could but read it. Forts and tombs express the spirit of the old *régime*, its selfish tyrrany and barren pride, just as the canals of living water, and the unregarded graves of the Britons who built them, illustrate the more peaceful, unselfish, and utilitarian tendency of the new era.

How long this pacific period may endure it is now impossible to say. Secure as the Government may be against internal disaffection there is no misunderstanding the ceaseless movements along the north-west frontier and upon the great plateau beyond Kashmir. The English conquest, bloodiest and least glorious of all their Asiatic exploits, has ended in the Panjab, where other invaders began, and now the British too, with India subdued behind them, have their faces turned in the same direction as those whom they supplanted. A fringe of predatory tribes retain along the frontier the habits and ideals of Highland reavers, remaining in a state of insuppressible insurrection, with nominal allegiance to

the Ameer of Afghanistan on the one side, and imperfectly-fulfilled pacts with the British on the other. But it is not for these that there are forts in the passes, railways thrust towards them, garrisons on the watch, and subsidies to the wild hill-men. Beyond Kabul and beyond Kandahar, nearer than Merv and closer to Herat, glitter the lances of the Cossack and floats the advancing standard of the Czar. With intervals of apathy and forgetfulness, with flashes of feverish impatience and anxiety, the sentinels from Peshawur to Quetta wait for the long-looked-for signal which shall tell of yet another invasion of India. It will come through the same passes, by an until lately unknown race, filled with the same ambition and the same keen appetite for plunder, which actuated the hordes, that from times before records until now, have marched eastward to make the peninsula their own. Once more the Panjab will be the centre of resistance, and once more the fate of India will be thrown into the scale of war.

CHAPTER X.

THE AGRICULTURE OF INDIA.

Having made the circuit of the provinces, there is yet another aspect of the country as a whole and of its people demanding to be dealt with, in order that its irrigation may be appraised. This is its agricultural development and its prospects, which have formed the subject of much enquiry of late years.

"Of all branches of Indian industry, agriculture, which constitutes the occupation of the great mass of the people, is by far the most important. We believe it to be susceptible of almost indefinite improvement. . . . Agricultural and commercial progress go together." Such was the opinion expressed by Lord Mayo and his Government in 1871, giving official endorsement to a commonplace of Anglo-Indian experience. That India is almost wholly an agricultural country has been already pointed out, and that commercial progress inevitably follows that of agriculture is true everywhere. It is the second assertion of the paragraph, that agriculture is susceptible of almost indefinite improvement, which requires comment. In a limited sense this is true all the world over, but as the possible inference in the minds of most people would be that the statement is intended to convey a reflection upon Indian agriculture in particular, it is of moment to know at the outset what its prospects really are. Necessarily the condition of agriculture is a chief element in determining whether irrigation works shall be profitable or not. The question as to the means and methods of the Hindu farmer is therefore of the first importance. Are these capable of indefinite improvement? Is their present condition so very bad?

A few years ago the probabilities are that such queries would have been answered unhesitatingly in the affirmative. It was clear to the most cursory observation that the ryot cultivated his patch of land without any regard to the principles obeyed by the English or American farmer, and the conclusion was at once arrived at that the ryot was densely ignorant of his own business. European practices being right, Indian practices were palpably wrong. If the ryot could be induced to change his system altogether, and supersede that which his ancestry had followed for generations, by cultivation according to modern ideas, it was argued that "indefinite improvement" would immediately follow. The Hindu, however,

proved very obstinate. It was as much an object with him to arrive at the minimum of exertion as at the maximum of production. He aimed at quick returns, and regarding the customs of his forefathers with pertinacious veneration, declined to lightly lay them aside. For this he was reprobated more severely than ever by his scientific critics, and though a few revenue officers who had spent their lives in country districts, ventured to contend that on the whole the ryot really knew what he was about, and that his methods were fairly well adapted to the circumstances of the country, such opinions were generally scouted. It needed some hardihood to take such a stand on behalf of the naked labourer who worked with a burned stick, or a wooden plough, and trod out the corn from his sheaves under the hoofs of half-fed bullocks. It has become less difficult to maintain the favourable opinion now. The failures of many experiments conducted on western lines have bred a certain healthy modesty in the minds of some European onlookers, while the expressed testimony of a highly qualified critic like Professor Wallace has been given most emphatically in the ryot's favour. As he visited India independently of its departments, he cannot be accused, as the revenue officers were, of simply defending the *status quo.* Such agricultural teachers as there are have felt it necessary to justify their existence by declaring in favour of the orthodox theories of Cirencester. So far as the layman can judge, Professor Wallace and the ryot have reason on their side.

A little reflection ought to have indicated the likelihood of the Hindu having at least some justification for his persistency. The struggle for existence with him is very keen, while in patience, in industry of an even, easy kind, and in shrewdness at a bargain he has a good many resemblances to the French peasant. To suppose that men of this disposition would wantonly neglect such sources of profit as were within their reach, would not put to their best use such materials as they possessed, and would refuse opportunities for multiplying their gains when offered to them gratuitously, was surely to put too great a strain upon a theory of Asiatic conservatism. That there are deep rooted prejudices to be eradicated, and agricultural customs, which have become superstitions, to amend, is undoubtedly true, but in most, if not all of these, there is still a basis of reason. There has been, for all of them, a sufficient reason in some remote past. Instances of the willingness of the farmers to adopt inventions suited to their needs, though they are few, are not wanting. The Beheea sugar-crusher, worked by one or two bullocks, has been adopted almost universally. In one division the natives declined to buy them until one or two were lent for a season to leading growers; next year they were purchased by scores in all the neighbourhood. In another division, while always willing to borrow a light type of iron plough, they steadfastly refused to purchase, maintaining that the advantage gained is not equivalent to the outlay. Penurious to a degree in his outlay upon his farm, the ryot calculates the value of a new implement

with the greatest caution, and always prefers that his neighbours should try experiments for him. In these particulars, however, he is not singular, among the farmers of the world.

Undoubtedly the "indefinite improvement" hoped for in Indian agriculture must be first in the farmers themselves. It is perfectly evident that this will not be accomplished, until a stronger case can be presented in favour of reform than is usually submitted by Europeans, who begin with the assumption that they have only to teach, and the ryot only to learn.

It is now ten years since the Government of India, on the recommendation of the Famine Commission, decided upon establishing a department of Agriculture, and appointed Sir Edward Buck, well known in Australia in past years, as its chief. If ability and ambition on his part could have sufficed for the work, the best results would have been soon achieved. But at the very outset he was directed to undertake, in the first instance, the supervision of the land records of the empire—an immense task, which has been continued ever since, and is still far from final accomplishment. As the land revenue, which is the great source of income, is based upon the assessments made from these records, the paramount importance of this duty cannot be gainsaid. The net gain to the revenue by departmental action is already over £200,000 a year. Nevertheless it was an unfair burden to impose upon a young office. In consequence the central department has done great work for the revenue, but next to nothing for agriculture up to the present time. The separate Presidencies have each essayed to grapple with some of its problems, and have accumulated by degrees a fair share of experiences, though it would be scarcely an exaggeration to say that in most cases the results are negative.

It is now admitted that there was a bad choice of the first managers, who were really gardeners rather than agriculturists, and that some of the sites of the farms were unsuitable for experiments. Nevertheless the failures obtained are instructive. After much entreaty the Government of India has taken a step onward, having a short time since obtained the services of the celebrated Dr. Voelcker from the Imperial Government. He has made an exhaustive examination of the agricultural possibilities of India, and is presenting a report. A conference on the question has been held at Simla, and resolutions arrived at to which it is proposed to give effect if, upon the report of Dr. Voelcker, they still appear judicious. It is intended to take immediate action after the consideration of that report to put Sir Edward Buck in a position to carry out his projects for agricultural education, and therefore it may be anticipated that the Indian Department of Agriculture will soon be organised upon a new basis, and begin the practical action which has been postponed so long. Meanwhile good work is being done by agricultural shows and experimental cropping.

Whatever Dr. Voelcker's report may contain, it may be safely prophesied that it will not reveal much of the mind of the ryot. Suspicious of his landlord, when he has one, suspicious of the

Government as his tax collector, and suspicious of all unofficial inquirers as having a design upon him, the farmer at his best is usually incommunicative, and at his worst is deliberately misleading. Sir Alfred Lyall, who knew him well, depicts a farmer as saying :—

> There comes a settlement Hakim, to teach us to plough and to weed ;
> I sowed the cotton he gave me, but first I boiled the seed ;
> He likes us humble farmers, and speaks so gracious and wise,
> As he asks of our manners and customs ; I tell him a parcel of lies.

Under such conditions, it may well be surmised that the ascertainment of Hindu methods, and of the reasons for their adoption, is by no means easy. All that is now known has been gathered by the patient scrutiny of canal and revenue officers, or from the more intelligent members of the class. Professor Wallace declares that some of those with whom he conversed were quite as well versed in their business, and as well informed as to the properties of their land, and the grasses with which they had to deal, as white farmers are. But, so far, little of the local knowledge has been made available, and it must be confessed that the Agricultural Department knows next to nothing of the soils of India, or of their main products from scientific observations of its own. Until this knowledge is mastered, and the methods of the people have been thoroughly examined, it would be premature for Dr. Voelcker to dogmatise either in praise or blame of the ryot or to attempt to propose reforms.

It has been quite a mistake to suppose that a rotation of crops was not followed, for as a matter of fact there are many rotations in use in all parts of India, and some such practice is found everywhere. Fields are regularly fallowed, and in many districts manure is carefully collected and judiciously employed. Those who have attempted to introduce iron ploughs have met with but moderate success, and for good reason. In the first place Indian cattle are not strong enough to draw them, in the next place in many soils their use under a hot sun simply bakes the earth into bricks, while the native habit of ploughing immediately after rain, or irrigation, in what is simply mud would be impossible. Finally there is the great difficulty of getting them repaired. Repeated scratchings of the surface are all that is needed for most crops, and these are given by frequent ploughings, so that in the end the best results are often obtained, not with the imported plough, but with the sharp, pointed stick, which serves the ryot for that purpose, and upon which he has to throw his weight in order that he may make an impression on the soil. There are cases where deep ploughing has been found to be advantageous, as for sugar cane, or in certain loams, but the knowledge when to use the iron and when to use the wooden plough has yet to be gained. If then comparatively little is known of Hindu farming, it is none the less sure that many of the innovations pressed upon the ryot would have been less profitable to him than his existing methods are. Can it

be wondered then if he regards all new proposals with distrust? It has been proved to him that his European advisers are not infallible, and that their recommendations need to be well considered. The principles of European agriculture have yet to be adapted to an Indian environment. This will be the first duty of the reinvigorated department.

It would be to run to the opposite extreme to suppose that the farming of the Hindu is as good as it ought to be. While very far from this, it is sometimes as good as it can be under existing circumstances. The circumstances are unfavourable. Cattle droppings, which should yield the largest quantity, and excellent quality of manure, are used as fuel, and though the ashes are preserved and returned to the fields, some of the most valuable properties are lost. It will be impossible to avoid this waste until other fuel is furnished. Although the cattle in Bengal are twice as numerous in proportion as those of the United Kingdom, they could not be trusted to perform one-half the work, not merely because they are small, but because they are ill-fed. Nothing can be done to improve them until better food and more of it is secured for them. The implements employed are of the simplest—most of the work on the farm, from clearing to weeding, being done with an adze-shaped hoe. In road-making, and canal excavation, a few rude baskets are used as well. As the Hindus almost invariably work squatting on their haunches English tools are unsuitable. A great deal of cultivation is done by hand in market-garden style, but the failure to return to the soil the proper elements necessary for its full fertility, renders the crops shorter and thinner than those which Australians are accustomed to see, except in bad years, or in those districts where continuous cropping has already impoverished the soil.

The situation is intricate in every aspect. An Indian farmer fully appreciates manure, but cannot afford to purchase it. The fields nearest the villages fetch a higher rental because of their fertilisation with the refuse. But this bears no proportion to the whole area in need of replenishment. Density of population operates both for and against the ryot. It leaves him but a plot to attend to; those who have not tenant-rights often owning (in Behar) no more than 1½ acres; hence they can devote an amount of care to its tilth impossible on the larger blocks worked in Anglo-Saxon communities. In some places only 6 per cent. of the land remains for grazing, all the rest capable of cultivation being under the plough. It is easy to perceive that there remains plenty of scope for the improvement of agriculture, but that to do it the work must be begun upon a broad basis, and carried out gradually. A revolution in the condition and practices of millions is not accomplished at once, even in India. Nor can one reform be effected without others. Gradually the whole system may be brought into better order.

The wants of the ryot may be soon recapitulated. First and foremost, water, to supply which the State has already done much; next manure, *i.e.*, to preserve the scanty store of cattle droppings

now consumed, for which wood fuel must be substituted; and finally fodder, for which reserves must be set apart. Experiments with ensilage have met as yet with only a limited success, but there is hope that the process may be perfected so as to provide for the carrying on of surplus herbage to seasons of dearth. Wood and fodder may be obtained from the same sites. Green manures are even now occasionally employed, and a further study of their possibilities may prove an important addition to the fertilisers. With water, manure, and fodder, the ryot would enter upon a new era of production, and a new order of cultivation. For it need not be repeated here that it is the ryot only that is to be considered. White planters deal with tea, coffee, or cinchona, exportable products which affect the farming community merely by their demand for labour, and which need not figure in a review of Indian agriculture. The millions of native peasant proprietors, and the 8,000,000 to 10,000,000 labourers who, though landless, gain their living by working upon the soil, dwarf all white enterprise to insignificant proportions, except in Customs returns. To provide these masses with fodder, manure, and water is a Herculean task which will require years to accomplish.

One other end may also be from the first kept well in view. Owing to the immensity of India, and the defective means of communication enjoyed, a reform which should be undertaken without delay is that of the methods employed in backward districts, by the introduction of those which have been found successful in native hands elsewhere. Owing to the difficulties of communication, which existed until recently, it has been possible for even contiguous provinces to remain unaware of their neighbours' practices. Those which have been badly ruled, under the domination of landlords, or subject to foray and raid, have preserved much ruder systems of tillage than those with better opportunities, while sometimes a lucky hit or special intelligence has struck out an improvement which is not known beyond a narrow area. The best native experience, if widely diffused, would mean an immense advance in many portions of India, and being native in origin and character, would be more likely to secure a favourable reception among Hindus. By the time this is achieved the general spread of education may have weakened those bonds of caste which hamper the operations of farmers everywhere. Railway travelling has already led to a mingling of high and low castes in the same compartments, which previously would have been bitterly resisted. Brahmans will now purchase bone-dust and employ it upon their farms, although strictly they ought to be outcasted for so doing. As barriers are more and more broken down the agricultural classes will be able to work, produce, and exchange, with greater freedom than they have ever yet done. In these directions there is the possibility of a great and speedy advance, so that in another 20 years we might see agriculture, and the agriculturist of India, put upon a footing which would transform both, without much apparent aid from European ideas, or much ostensible dependence upon European skill. To

make the best of India, upon Indian methods, and by means of Indian agencies, is the first, and one of the greatest ends of the new Agricultural Department.

Beyond this begins the task of analysing soils, waters, and manures in the light of agricultural chemistry, and of studying native practices by the experience gained in other lands. Then, and not till then, will it be possible for the department to teach the ryot how to farm, with the certainty of demonstrating to him, by the hard logic of facts, that it is his interest to do as he is advised. It is perfectly certain that he will not hesitate to adopt such recommendations as are within his resources, when it is once manifest to him that he can profit by so doing. At present it may be taken for granted that however wise Dr. Voelcker's recommendations may be there will be very few of them of immediate value unless they conform to local conditions, and harmonise with the prejudices of the people. Prove to them that it pays to set aside their prejudices, and the most bigoted devotee of caste will not long resist the temptation to put money in purse ; spiritual advisers, for a share of the extra gains, will discover a loophole in the prohibitive maxims of their creed, or award an absolution, and after a sufficient time, will even embody the procedure, now denounced as heretical, among the orthodox practices of the caste. It is by such means only that the "indefinite improvement" desired may be made definite and actual. Dr. Voelcker is an extremely able man—an expert of European reputation—and it is to be hoped that he will recognise these local and racial peculiarities in his report.

In considering questions connected with agriculture, it must be remembered that the ryot is not the misguided blunderer once supposed ; that he knows his business as a farmer well, and that he cannot be improved upon unless the conditions under which he works are altered. These are capable of great improvement gradually and by native means. The task of practically educating the ryot has been undertaken in each Presidency. Owing to early blunders little has yet been achieved in Madras, where unfortunately a parsimonious policy appears to prevail in this branch. The department in Bengal proper has been overweighted like the Central Office, and underpaid as in Madras. The Panjab has, if anything, less to show than either, though some excellent work has been done in all three.

The field for agricultural expansion is more limited in Bombay, which is less dependent upon its own farms than its neighbours, but has none the less displayed a characteristic energy in its rural policy. Its Agricultural Department has been more of a reality ; has displayed more vigour and independence, and has issued excellent reports. One of its publications is a statistical atlas, showing at a glance the population of its several districts, their liability to famine, and the remedies most applicable in each instance. By this means the campaign against want may be carried on with knowledge, and an adaptation of means to ends, impossible under the sudden pressure of calamity. The situation on the whole is scarcely im-

proving from the State point of view, which is concerned with food supply rather than export returns. New difficulties have arisen out of the very successes of agriculture in that regard. The growth of wheat, and of oil seeds for shipment, has been so profitable as to encroach upon the area previously devoted to food grains for local use. The soil sustains larger demands; the rotation of crops is less regular; bones are sent out of the country, and the return of manure to the soil is absolutely insufficient. The population in times of peace and prosperity has gone on multiplying, and the limit of cultivation within the Presidency has now been nearly reached. The Agricultural Department perceives the dangers ahead, but does not possess powers sufficiently great to conquer them.

Agricultural shows appear to be exciting interest, and at Kolhapur, where a show and fair was held conjointly, there were in 1889 no less than 22,357 animals exhibited, as against 6,663 in 1885. The stock interest is being studied by setting apart one State farm for breeding, and another for the production of good milkers. In this connection it may be noticed how English practice and the influence of its ideas are modifying the circumstances of native life. Formerly the cultivator found no difficulty in having his cows served by some of the many bulls, which either at funeral ceremonies, or in fulfilment of a vow, were dedicated to one of the deities, or else were freed by strict Hindus who would not traffic in cattle. These animals were always strong and sound. and as they were never worked, but roamed at large, feeding at will upon crops and pastures from which they were rarely driven, furnished fairly good sires. The Cattle Pounds Act, however, makes no distinction between a sacred and any other bull; pious people of the neighbourhood grow weary of perpetually buying them out, to prevent them being purchased and killed by an unbeliever, while the decaying religious zeal of the community is manifested by the rapid decrease in the number of animals dedicated. The ryots appreciate a good stud bull, and sometimes even combine to purchase or travel far in search of one, but under the altered circumstances, it is becoming a necessity for the Agricultural Department to take steps to provide good stock for the purpose.

A brighter prospect for stock raisers has been already opened by the departmental successes with lucerne and ensilage. On the Sind farm at Hyderabad, lucerne has been proved the best paying crop. is now cultivated every year, and is coming into favour with the wealthier natives. Probably there, as in the North-west, it is unable to endure the scorching heat of summer, and requires to be sown afresh each year as a winter crop. When I had an opportunity of seeing a small patch it was very thin and ragged, in no way approaching the average growth which may be seen in Victoria. Guinea grass, much thought of in Madras, is hardier than lucerne, giving in 1889 six tons to the acre, a yield much below the average. At Poona, 2,000 feet above the sea, ensilage has succeeded, although discouraging results were obtained both in Madras and Bengal. A

pit silo having a capacity of 4,050 feet was filled with 68,000 lb. of jowari (sorghum vulgare) cut at the end of summer. The loading occupied 15 days, when the silo stood a foot above the brim. Then a layer of 4 inches of weeds was put on, and when the temperature rose to 120 F., the top was plastered with 2 inches of clay and weighted 200 lb. to the square foot. Four months afterwards, at the beginning of next summer, the silo was opened and found to have sunk 2 feet below the brim. It was in excellent condition, and was eaten greedily by cows that had never tasted ensilage. It is at this season that fodder is scarce, and hence this demonstration of the possibilities of winter silos, is of the utmost importance to such of the ryots as have the capital necessary for the operation.

Experiments are now proceeding at the farms to test the seeds of different varieties of cotton, of Australian and other wheats, of fertilisers for tobacco, and of barilla as a plant for the reclamation of lands impregnated with carbonate of soda and other salts. But what is most wanted is a scientific knowledge of practical expedients for improving the ryot's methods. The interculture with cotton of winter crops, such as wheat and linseed, so that if one fails the other may succeed, is strongly recommended. There is also much need of a knowledge how to cope with insect pests, such as the rice grub, which destroyed the crop in one district for three years in succession. Certain of the natives as well as some of the local bodies have been induced to contribute towards the prize funds for agricultural shows, but for the most part it is the Government alone that moves in these matters. The ryot is utterly unable to help himself, exercises little or no prevision, and is altogether ignorant of the world beyond his village, or of the movements in it which determine his prices. For all that lies outside his fields he is dependent upon others, and also for a knowledge of what ought to be done in them, when new circumstances dislocate the ancient courses of trade.

It is the Agricultural Department of the North-west that has been making the most systematic attempts to reclaim tracts of land. which have been rendered barren by their impregnation with salts. Some of the plots have been for 15 years under culture, and are still unconquered. For a time crops flourish upon them, but so soon as the roots reach the nodular limestone below they wither. Of course it is possible, by means of persistent fertilisation and cultivation, to obtain a good soil upon any site, but the process is not remunerative. When trenched with nightsoil, and well irrigated, the poorest patches soon become productive ; but this is only possible for limited areas near large towns. When the "usar," as it is termed, is below canal level, it is always practicable, by means of colmatage, to put upon it a new soil, formed by deposits from the canal water, whenever, owing to rains or floods, it is heavily charged with silt. Such land is invariably fertile, and lets well. If water can be dammed back upon the "usar" sufficiently long, it almost invariably results in a luxuriant growth of aquatic grasses ; but whether it can be rendered fit for agriculture

by this means is not yet determined. By far the most promising plans of reclamation yet proposed are those now in operation near Cawnpore. On one plot the land is protected from the encroachment of cattle by means of fencing or ditches, and the patchy growth of vegetation which follows is carefully watched. Saltbush is planted in likely places, or in pits filled with better soil, and it is thought that by this means the land may be gradually covered with vegetation, akin to that which springs up on the sand hummocks of the Australian coasts, where they are protected against stock. On another site cattle are pastured upon adjacent lands, or upon the usar, where it carries edible herbage, and their manure is worked into it by means of frequent ploughing. The milk of the cattle is sold to provide for their maintenance. It is found that land so treated becomes cultivable much earlier than was anticipated, and the hope is now cherished that by this simple means a considerable area of worthless land may be gradually made rent producing. The denudation of the hill country having caused some alarm, an effort is being made to check it by means of embankments which will operate as storage until they are silted up with the collected deposits of rich soil at present washed away from higher lands. The beds could be cultivated in the dry season.

Such attempts as these to resist the losses of humus suggest at once the special difficulties of the country, over peopled as it is in particular parts, where the soil itself has to be created before husbandry is possible. The lesson which it furnishes is especially marked, when its condition is compared with that of an under-peopled continent like Australia, and it is necessary to bear this in mind continuously. The holding of the poorer selector would appear a great estate, his simple fare sumptuous, and his bark hut palatial to the Hindu, three-parts naked, living on coarse grains and wild fruits, housed in mud and straw, without machinery, and almost without implements. The Agricultural Department of the North-west does its best to repair his deficiences, and in order to help him devotes its attention to experiments with early and late sowing, and improved methods of farming; grows its own crops, so as to be able to forecast from them the yield to be expected each season; produces pedigree seed for distribution, and makes and sells simple implements at cost price. There was a time when its agents travelled the country like hawkers, exhibiting its ploughs, working them, and selling them on the time-payment system, but owing partly to the misconduct of some of its officers, and partly to the difficulty of recovering anything from the peasants who purchased, this extraordinary development of paternal government had to be abandoned. Natives visit the State farms and are presumed to carry away fresh ideas; there is always a demand for men who have served their apprenticeship upon them, or in the gardens at Saharanpur and Lucknow; and the agricultural shows, at which simple machinery is always exhibited in action, are thought to be having, though slowly, an excellent effect. The wily Hindu, however, requires to be watched in the prize taking, since he can spend, and

does spend, an indefinite time in ransacking his own and neighbouring districts for special qualities of grain, selected, cleaned by hand, and arranged with scrupulous care, so as to defeat all honest competitors.

The efforts of the Central and Presidential Departments by no means exhaust the whole of the stimulus which the British Government imparts to agriculture. The land system of India is responsible for certain peculiarities in its administration, which point to the natural results of State ownership. A preamble of 1803 says that "by the ancient law of the country, the ruling power is entitled to a certain proportion of the annual produce of every piece of land, excepting in cases in which that power shall have made a temporary or permanent alienation of its right to such proportion of the produce, or shall have agreed to receive instead of that proportion a specific sum annually, or for a term of years, or in perpetuity." In an official handbook which Sir James Fitzjames Stephen declared to be superior to the Acts upon which it was based, it is pointed out that "so long as the sovereign was entitled to a portion of the produce of all land, and there was no fixed limit to that portion, practically the sovereign was so far owner of the land as to be able to exclude all other persons from enjoying any portion of the net produce;" and again it is added in the "Directions for Settlement Officers" that "Under Indian Governments there is practically no other limit to the demand upon the land than the power of the Government to enforce payment and the ability of the people to pay. Thus the Government is in fact the landlord of the whole country." Here we have the single tax ideal in actual operation.

Under such a system all waste and unoccupied lands belong to the Crown, and their utilisation becomes of as much interest in this old civilisation as in new colonies, where vast unsettled areas have proved up till now invaluable sources of revenue and of public prosperity. Irrigation schemes everywhere, by broadening the culturable area, and pushing dry farming outward, have led to the taking up of lands to replace, or to be worked with those brought under the channels. In Madras especially this has proved an additional source of income to the State, which can fairly be credited to irrigation accounts But there, as in the North-west, the effect has been merely an extension of already cultivated districts, which become bordered by a new fringe of settlement, or else an acquisition of blocks of unused country intermingled with those under agriculture, which have heretofore remained idle because of their being above the level of supply, overrun with jungle, or of inferior quality. In the Panjab there has been another development. Canals have been constructed leading into large areas of unpeopled Government land, to which it has been necessary to attract immigrants in order that the water may be employed, and the scheme rendered self-supporting. Villages have been established, not unlike the colonies which private enterprise has scattered over Southern California and Colorado. The conditions and results of this departure are of special interest in Australia, where Mildura and Renmark represent the advance guard of this mode of settlement.

Under the Sidhnai Canal there were 118,000 acres of Crown land. In 1886 the problem of securing occupation faced the Government of the Panjab very seriously, since there was then but one-third of the 64,000 acres irrigable from this scheme in the hands of cultivators. "The process of settling an agricultural population upon waste lands, hitherto uninhabited, and which cannot be cultivated without artificial irrigation, is both difficult and peculiar. In some respects it is analogous to the foundation of a colony," wrote the finance secretary in his letter to the central Government in that year. The returns for 1889-90 show that nearly 64,000 acres were actually watered in the Kharif season, and though 10,000 acres of this received an imperfect supply it is evident that the whole tract has been brought under the plough during three or four years. The same practice has been pursued under the Sirhind system with equal success, while the Chenab and Jhelum projects are avowedly undertaken in order to water large areas of outlying lands, which will require to be settled before the canal supply can be utilised at all. Considering the races to be dealt with and the prevalent dislike, of the farming castes to leave their districts, the new task imposed upon the officials has been by no means simple. They were required "to build up from the very rudiments, to settle a population, to attract cultivators, to provide for the foundation and management of villages, to organise and pay the ordinary rural agency, and in fine to establish the whole economy of a new society." The country west of the Satlej at Fazilka was dry, barren, and desolate, until the construction of the Lower Sohag canal, since which 50 villages have been created, with over 60,000 acres of watered land among them. In this respect, therefore, the province has undertaken a special and arduous work in connection with its irrigation. It is encouraging to learn that it is being pursued to-day with triumphant success. The annual value of the crops grown on two of the smaller schemes is estimated at upwards of £300,000, reaped from country which a few years before, maintained nothing but a few goats and black sheep.

The conditions of settlement differ in minor respects under different canals. The rajbahas, or branch channels, of the Sidhnai supply distributaries with an average length of two miles, commanding about a mile of country on each side, or about 2,500 acres in all. This is made the village block, but of course the size varies somewhat under other circumstances. Each block under the Sidhnai was surveyed into squares of 22·5 acres, and four of these, or 90 acres, were allotted to each settler. This is larger than the usual holding in the province, but was made so to encourage applicants, and also to induce them to undertake the expense of sinking a well, and of maintaining cattle to work it, which is only possible in the Panjab for what may be termed well-to-do farmers. A five years' lease was given of each allotment, the charges being 1s. 4d. per acre cultivated, 4s. 6d. per acre watered in spring, and 5s. per acre watered in autumn, with 3d. in the shilling for village officials and local rates. The digging of a well means the reduction of 2s. 4d. a year,

per acre watered by it, for 20 years; 1s. in spring, and 1s. 4d. in autumn. The rent for the 90 acres is £1 a year, and the holding can be purchased at 6s. an acre, or £27 for the allotment, after the expiration of the lease. The covenants inserted are something like those attached to the preliminary licences and leases granted to Australian free selectors—no transfer or assignment is valid without the consent of the Department, one half must be cultivated within three years, and two-thirds within four years after possession is given; a proportion of the cost of any irrigation channels constructed has to be paid, and all minerals are reserved. Not only does the State not bind itself to supply any water, but an addition is made in the shape of a declaration that nothing in the deed confers any "right, title, claim, easement, or privilege whatsoever to or in respect of any water," a condition which would be of enormous value to the Australian Governments if it had been inserted in all grants from the early days of the colonies.

The first intention was to relieve the overcrowded towns of their surplus population by means of these settlements, but a very little experience indicated that such a procedure must be unsatisfactory to all concerned. Townsmen make bad farmers and are especially feeble in pioneering knowledge and courage. General Booth's proposals for colonies over sea, unless safeguarded by much consideration, would be liable to the same disaster. The men now accepted are very carefully chosen from those who have cultivated already, and officers take a pride in securing for the new villages within their domains the most intelligent and energetic castes of farmers. Head men, as they are termed, are sent into overcrowded tracts to beat up recruits and arrange an exodus, receiving one or two allotments as a free grant for their services if they are successful. When the body of emigrants arrive they find the land already marked out, and their particular holdings are then determined by lot, as in the old Victorian style of selection. Precautions there, as in Australia, require to be taken against "dummying." In the later settlements and unattractive districts, water rates are now sometimes remitted one-half for the first two years, and one-third for the next three years, in addition to the remissions which the colonists receive with all other taxpayers in the event of a partial or total failure of crop. The various castes and creeds raise no objection now to joining in one village, and though they begin by preserving their lines of demarcation, it may be hoped that communal ties and obligations will tend to obliterate them more than it has done in the old villages where they are similarly mingled. The Government, in the new settlements for which it is responsible, attends to the health, drainage, and commonage, of each little community, and thus takes the place occupied at Mildura by the shire council, as well as that of the Messrs. Chaffey.

The attempt to establish a fixed rate of rent in perpetuity for land has been made in India more than once, and is, perhaps, still the ideal towards which some officials may confess a leaning. Outside Bengal, however, this tenure has nowhere attained large

proportions except in Madras, and probably is not more than 10 per cent. of the settled area of the North-west and Assam. In 1862 Sir Charles Wood decreed that the experiment of its adoption should be tried in Upper India, and a strong effort was at once made to carry out his wishes. Two years afterwards villages in which the cultivation was less than four-fifths of the culturable area were excluded, in 1866 estates likely to be enhanced in value by means of the Government irrigation works were also excepted. and finally, in 1870-71, the whole basis of Sir C. Wood's calculations being questioned, the policy was cancelled altogether. In 1882 it was announced that no further attempts would be made to follow the bad precedents established in Bengal under Lord Cornwallis. The significant feature of this failure is the complete indifference with which the offer of a perpetual rent was received by the native proprietors. The chief objects of the Government, in making so great a concession, were to earn their goodwill, and to secure a better treatment for sub-tenants. The first it was evident they could not accomplish by such means, while the second theory was absolutely absurd in the face of the experiences in Bengal, from Behar to Orissa. The principle which now obtains, therefore, is that the State determines the land tax from time to time, not increasing it in consequence of the owners' improvements, but retaining power to advance it upon fresh land brought into cultivation, or rendered irrigable by national works, or of which the produce has materially increased in value. These are the rules in time of peace ; in time of war or crisis there will here, as everywhere, be no other limit except that of the capacity to pay.

The aim of the Government in India, as in Australia, is by every means in its power to induce its lessees to become freeholders, its objects being to satisfy the earth hunger which is probably even stronger in them than in the white, to induce them to improve their properties, and by increasing their stake in the country, and their interest in the preservation of order, to render them better citizens. It might well be urged on the other hand that they have become thoroughly accustomed to leasehold tenure, and that of themselves they would aspire to nothing more, that the security thus given is ample, and that the State, by retaining its ultimate control of the land, is enabled to a certain degree to protect them against themselves. The improvidence in regard to festival and ceremonial expenses, which accompanies the habitual daily penuriousness and thrift of the Hindu, places thousands of peasants utterly at the mercy of the money-lenders, who are building up great estates and rack-renting their tenants in the good old style all over India. It may be also pointed out to those in favour of freehold, and those opposed to it, as an argument that might be used on both sides, that the Government does not relieve itself of responsibility when it does give away the fee simple. In Bengal the legislature has already been compelled to pass several acts for the protection of tenants, and at the present moment another act is meditated in the Panjab, which would limit in a very summary

way the power of the ryot to mortgage his land. Legislation of this kind is certain to increase, and to become more drastic in each decade, for the evil must be coped with unless the peasants are permitted to become the serfs of the Banyas.

Lord Ripon said that "if, through rack-renting, or any unsuitable system of collecting rent, or if from inability to obtain capital on reasonable terms . . . the amount of produce becomes less than sufficient to provide the sustenance and appliances required by labour and land, it becomes the imperative duty of the government to ascertain whether any legitimate means can be provided to check the degradation of agriculture, which must otherwise ensue." While therefore giving fee simple with the one hand, the State is changing it into something very like a leasehold, by limitations and taxation on the other hand. This appears to be the trend of development from Ireland to Australia, a certain "nationalisation of the land," or something like it, being everywhere slowly accomplished in much the same way. Even in America, a country which might be considered to be the antithesis of India in every respect, the bulk of the farms of some of the most important States are already mortgaged up to the hilt, the agriculturist is becoming a mere tenant, and labourer for the money-lender, and the new political party now threatening Republican ascendency has for its mainspring the revolt of the cultivators. A similar rural discontent may be noticed asserting itself and demanding a remedy all the world over.

This brings us naturally to the consideration of a still more suggestive State interference in India, that by which advances are made to farmers, whether freeholders or tenants, from the public funds, for the purpose of permanent improvements to their holdings. This is the exact proposition of the new farmers' party in the United States, which has been made more or less crudely during the last ten or fifteen years in Victoria, and may be said to have been now adopted on a small scale by New Zealand, in its village settlements, which appear to have achieved a certain amount of success. Mr. G. W. Cotton, M.L.C., of South Australia, has long identified himself with an agitation for the adoption of the principle, in a limited degree, in connection with the working-men's blocks which have been established chiefly by his exertions in that colony. It is doubtful if any of those who have broached the idea in Australia, had any conception that the system of State aid to farmers was in active operation in any part of the British Empire, and least of all in its great Asiatic Dependency. Yet, as a matter of fact, the practice there is of ancient date, and was fully expressed in the Land Improvement Act, XXVI. of 1871, since repealed and amended by No. XIX. of 1883, which applies alike to all the Presidencies. A certain sum is set apart every year in each of them—in Madras and Bombay £20,000 per annum—which is disbursed in loans to individual cultivators, who may even base their claim upon the ground of their distress. In the great bulk of the cases, however, the application is only entertained in order that improvements may be

made upon the holdings. "Improvements" are defined to include "any work which adds to the letting value of land," and it is to be noted that in the indication of these the first place is given to "wells, tanks, and other works for the storage, supply, and distribution of water." Then comes "the preparation of land for irrigation," and next its "drainage, reclamation, protection from floods or erosion"; after this are placed the renewal or reconstruction of the foregoing, and then with a "drag net" conclusion the word is made to embrace all other works which the local governments, with the sanction of the Governor in Council, may declare.

The maximum term of the loan which may be granted to a village, or an individual, is thirty-five years, and provision is made for its summary recovery when necessary. Each presidency makes rules as to the methods of application, inspection, security and repayment. The improvements are not reckoned in the assessed value of the land on which rent is paid, until after a fixed term. In the Panjab and in Bombay, if not elsewhere, advances have been conceded for the purchase of cattle, thus indicating considerable elasticity in the interpretation of the meaning of the word "improvements." They are also permitted for the purchase of seed grain, but in this instance the debt must be repaid in one year, or if incurred for stock, in two years. In the latter case, having an intimate knowledge of the possibilities of Hindu trickery, the Government itself purchases the cattle for its borrowers. Surely the wits of the *laissez-faire* school had never a better opportunity of exhibiting their cleverness than in the dissertations in which a knowledge of this fact should enable them to indulge. The British Empire may be pictured in the person of its officer, armed with the sanction of a Viceroy, of a Governor and his Council, of an Act of Parliament, and a code of minute regulations, buying buffaloes for the ryots, examining their mouths, making sure that they are sound in wind and limb, and taking special care that the seller is not a friend or relative of the half-naked pagan to whom they are about to lend the few rupees necessary for the purchase. Where is there so paternal a Government as this? Where is there such an approach to the industrial partnership which Socialists glorify?

The steps by which the unhappy Jat, whose cow has died, or whose well has fallen in, betakes himself to the Mont-de-Piété which the mighty Indian Government manages for his benefit, are few and simple, as becomes the transaction of an illiterate peasant. He makes an application on stamped paper, for which he is required to pay 1s., in order to prevent the shoals of dishonest pleas that would otherwise pour in. Stating his name, profession, parentage, tribe or caste, and residence, he describes exactly what he proposes to do with the money, if he gets it; shews that the expenditure will be reproductive, and specifies the sum he will lay out upon the work from his own resources. If he asks for more than £50, he is required to furnish a rough plan; and if for more than £500, an accurate plan, specification, and estimate. If thought wise, the officer can get these plans prepared for him on payment of a reason-

able deposit. Public notice is given in the neighbouring villages of the application, and of the time of inquiry into the alleged facts of the petition, when the Deputy-Commissioner, attended by some of the chief people of the place, investigates the circumstances, takes evidence, and makes his report. If the cost be above £500, a Public Works officer criticises the scheme. In Bombay a collector may authorise advances in this way up to £250, a Deputy-Commissioner up to £500, the Government of a Presidency up to £1,000, and the Government of India sums above that amount. In the Panjab a Deputy-Commissioner may grant up to £50, and a Financial Commissioner up to £500. There is an appeal against a refusal.

The security offered must be either that of the land, or a tenant right, though in some instances personal security has been taken; there should be a margin of 25 per cent. between its value and the sum advanced. Loans under £500 must be repaid, with interest, in seven years; above that amount the limit of time is 10 years in the Panjab, and 12 years in Bombay, and 40 years is the maximum under any circumstances. Interest in the Panjab is charged at the rate of 6 per cent., and in Bombay 6¼ per cent., about the same rate obtaining in the other Presidencies. No separate instrument is necessary to mortgage the security in the Panjab, the applicant simply endorsing a certificate of receipt with the declaration that he understands his obligation. In the case of large advances, the recipient is required to keep accounts in prescribed forms, which are always open for inspection. A penal rate of interest is levied in the event of any delay in payment. The local government can, and occasionally does, reduce the interest charged in special cases to 4½ per cent. and in some others remits it altogether, so that the whole system depends upon the integrity and judgment of the officers, to whom the act is a guide, but who are allowed a very large discretion in its administration. So far no complaints have been heard regarding it, and after 20 years' experience it may be considered an integral portion of the political system of India. During Irish famines and after flood ravages, European Governments have occasionally done something directly in aid of their citizens, but nowhere has the State come to the rescue of its poor as systematically and generously as in India, where it feeds them, teaches them, finds them land and water, and lends them money to buy seed or cattle, or build their houses and dam their streams.

That there should be irrigation colonies in India, and that the "single tax" should be in operation, although not single, will be less remarkable to most than the knowledge that Indian farmers can borrow from the Government 75 per cent. of the value of their estate in land upon easy terms, in order to improve their agriculture. The Australian farmer with a freehold security can obtain 60 per cent. of the value of his holding at about the same rate. The reason for the Indian departure is no doubt that the rates extorted by the native usurers range from 25 per cent. as a minimum, to 50 and 60 per cent. as a comparatively common thing. Hence borrowing begets ruin far and wide. The valuation accepted is that of

the State assessment, which might be likened to the municipal rating, the standard adopted for water supply loans in Victoria, but is usually somewhat higher. Liberal as are the provisions under the Victorian Irrigation Act, and unparalleled colonially, except in South Australia, they are not nearly so favourable as are the conditions under which the Hindus obtain their water supply, and the money necessary to enable them to make the best use of it. This Asiatic despotism after all is kinder than any democracy has yet proved itself to be. Here, as elsewhere, the *laissez faire* doctrine has been abrogated by the needs of the situation, and the State has stepped in to save its people from penury and serfdom. There are yet other steps to take in this direction. It will probably be found within the next few years that the greater part of the advances on land in the Panjab will be made by the Government, and that the native usurers' trade will be seriously limited, if not destroyed. This may be "contrary to the laws of political economy," but it will be a wise and beneficent measure to the thousands of natives who are clearly incapable of managing their own financial affairs, and who periodically become a burden upon the Government in consequence of their mismanagement. When "freehold" spells mortgage, and complete "liberty" of dealing with it leads to starvation, it becomes time to reconsider a policy based even upon those attractive words.

Improvement in the agriculture of India will be limited in the near future by no other burden than that of taxation, and will be made as fast and as far as the intelligence of its peoples permits.

CHAPTER XI.

INDIAN WHEAT AND AUSTRALIAN TRADE.

Food grains have a place apart in all countries, and especially in India, where wheat is the only great article of export in which the country competes with white growers. It is as exchangeable as gold. and therefore as generally sought both east and west. The universal wants of man are food and clothing. Under these heads are included the greater part of the production and commerce of the world. As wheat and wool are two of the principal staples by which these wants are supplied, the Australasian interest in their exchange is paramount. In wool the supremacy of the colonies appears secure, but in wheat supply they are still beginners. The question has been raised already as to whether, for one reason or another, it is worth while for us to endeavour to gain a better place. The answer to be given must depend upon prices, and these in their turn upon our competitors, and upon the permanence of the demand abroad, to meet which our exports are despatched.

Most countries provide their own food. The wheat trade of the world depends upon the deficiency of Western Europe, and practically upon that of Great Britain, where far larger quantities are required, for manufacture as well as for consumption, than its agriculture at present supplies. With a radically reformed land system it would be possible for the mother country to greatly diminish her imports by increasing her home production. Belgium, proportionately as small, and as industrial as Great Britain, contrives to satisfy her own wants, and it is therefore possible to foresee a time when a much nearer approach to a balance between local demand and supply may be established in England. The second cause of European wheat purchases is climatic, and though operating irregularly, is scarcely likely to be coped with for a long time to come. Unfavourable seasons in France, Germany, and England, are not uncommon, and in such emergencies the wants of their dense populations have to be met by importation. The average annual quantity required in London over and above the English crop is about 150,000,000 bushels. It is to supply this demand that alien peoples at the ends of the earth unlock their barns, and despatch their cargoes. The world annually harvests more than 2,000,000,000 bushels, valued at upwards of £400,000,000

a year. The sum paid to supply the European deficit is about £30,000,000 yearly. For this price there are many competitors.

The most formidable producer is, of course, the United States, which has now passed the 500,000,000 bushels at which it has been aiming for some years. Wheat is grown in all States, except in the extreme south, and the vast prairies of the centre and west could probably, of themselves, supply the whole of the European demand in average years. Then comes Russia with a 300,000,000 bushel production, so largely available for export that, if supplemented from the Balkan Peninsula and Asia Minor, under good farming, and with sufficient means of transport, its surplus might come in time to rival that of the States. This, however, is far from being the case. Then comes India with a production of 260,000,000 bushels, creeping up steadily to the Russian level, and with an average of nearly 1,000,000 tons for export. Beside these mammoth competitors the 42,000,000 bushels of Australasia looks very small.

There has been so much ignorance as to the wheat possibilities of India that opinions have oscillated between two extremes. Hampered formerly by the existence of an export duty, her first appearance in foreign markets in 1873-74 followed immediately upon its abolition. Her leap from an export of less than 400,000 tons in 1880-81, to nearly 1,000,000 tons in 1881-82, created something like a panic, and was very widely commented upon. The agricultural statist of the United States, after a careful study of the figures, declared in 1887-88 that there was no real expansion of the Indian area under this crop, and that nothing was to be feared by the American farmer from that quarter. Notwithstanding the consummate ability displayed by the department at Washington, in its studies of the question, its judgment in this particular was entirely mistaken, as the figures for recent years distinctly prove. Yet it would be unfair to make this contradiction without admitting that the mistake was natural and excusable, and that even to this day it is difficult for those on the spot, and impossible for those at a distance, to deal with the subject accurately. Instead of condemning Indian statistics, those who have visited the country will be inclined to wonder that it should be possible to furnish any reliable figures. The returns are steadily improving year by year, but it will be some time yet before their estimates of yields and storages can be exact, though of course their assessment of exports is absolutely trustworthy.

To understand the Indian situation it is necessary to realise one or two important facts. First, that wheat is not grown in the peninsula proper, but is raised only in the upper and larger half of India; second, that it ripens in winter, and is never a summer crop; and third, that it is very little eaten by those who grow it. The plateaux of Central India enjoy a rainfall which enables the ryot to rely upon his harvest with considerable certainty; but in the Panjab cultivation, especially of cold weather crops, is entirely dependent upon irrigation. The chief thing to bear in mind, however, is a mental picture of the cultivator himself and his holding. Both

have been too frequently sketched in these pages to require further description. Wheat is a cheap crop, and with cheap land, cheap labour, and cheap transport, the ryot is excellently fitted for growing it. His food, the millets and grams, with his pockethandkerchief clothing, represent the lowest possible stratum of economical living. If he is without machinery he saves its cost, a pit in the ground serves him for a barn, and if dirt depreciates the price of his grain it increases its weight. The keystone of his position as a grower is that with him wheat is always an extra. He lives by and on his summer crops, and can afford to sell the fruit of his winter harvest for what it will fetch. While the productiveness of his land lasts, whatever he gets in this way looks like a profit, since it comes over and above what he has been accustomed to receive. This of itself is sufficient to explain the rapid extension of wheat growing in India.

The total area under wheat in India has been estimated by no less an authority than Professor Robert Wallace as equal to that of the United States. This appears excessive. The probability is that the area is about 30,000,000 acres, of which two-thirds is in the British provinces, and the rest in native states. Something more than one-half of this area is cultivated by ordinary dry farming, chiefly in the central provinces and native states. The opening of the direct railway route between Bombay and Calcutta has helped to enhance export. In 1886 Bombay shipped 617,000 tons, but sent away nearly 200,000 tons in the first four months of 1891, had its granaries and railway yards blocked with piles of bags, and its harbours filled with steamers capable of carrying twice as much more. Nothing like the rush had ever been witnessed before, even in the great port of Western India. There are some millions of acres still available for wheat growing, by dry farming, in Central India, only waiting for population and railways, to become largely productive. Both these wants are likely to be satisfied. The people will steadily flow to them from the many congested villages of the north-west, and the enterprising Government of India shows no signs of relaxing its spirited policy of railway construction, so that a gradual increase in the production from this quarter may be looked to for years to come.

There is, however, another condition to be taken into account besides population and railways, and this is irrigation, which already plays a large part in the production of wheat. Probably 15,000,000 acres of this crop are now artificially watered, and without taking into account what the natives may be able to add by means of new wells and tanks, it is certain that the Government schemes will increase the extent of the wetted lands considerably within the next 10 years. There are 10,000,000 acres under wheat in the Panjab and North-west to-day, while the new schemes in the former, and the great Sarda project in the latter, will probably add another 3,000,000 acres to the irrigated area. The regularity and largeness of the yield from these lands makes them a formidable addition to the Indian total. There is also a considerable acreage

watered in which wheat is not yet grown, but upon which it would be grown at once if prices were sufficiently tempting. In the two provinces mentioned the possibilities of wheat are limited only by the possibilities of irrigation. Probably a considerable portion of the uncultivated acreage elsewhere would require a system of water supply to make it permanently productive. The construction of the required works will demand time as well as money, and probably not more than 5,000,000 acres, counting Government and native schemes together, is likely to be added during the present generation to the irrigated area available for wheat.

There are circumstances to be taken into account on the other side. The growth of population means an increase of production, if accompanied by increased cultivation, but it also implies an increased consumption. Wheat raising has brought prosperity to the Panjab, visible in the gold ornaments of the wives of cultivators, upon whom formerly nothing but silver was to be seen, and it has also led to the formation of comparatively luxurious tastes. Wheat, once only the food of the rich, is now largely eaten by all Sikhs, and is certain to gradually drive the comparatively coarse and poor millets out of the larder. This, however, is not peculiar to India. The Russian peasant lives on about the same level, and is too poor at present to be able to eat the grain he sows and reaps. He is equally ignorant of threshing machines, and even worse provided with roads. Any improvement in his position would doubtless lead to a similar improvement in his food. There are those who contend that even in America the maximum wheat output has been reached, and that the rapid multiplication of its citizens will reduce the exportable surplus, though it must be confessed that there is nothing apparent in the returns to justify such a conclusion. The tendency of the prosperity of wheat cultivation to increase its local consumption affects poorer communities only.

The rainfall always remains an important factor in India, for it seals the fate of the crop to the dry farmer, or to the irrigator who depends upon an inundation canal, while it may even affect those under perennial canals, where showers are often relied upon to eke out the purchased supply. There is rarely a plentiful harvest all over the country, and while the immense shipments from Bombay had been attracting attention, there were rumours of a probable famine in Madras. Local dearths of this kind need not necessarily affect the wheat export, since the deficiency in southern provinces would probably, save in very extreme cases, be met by importations of rice. The quality of Indian wheat is low, so that it finds its best market in the south of Europe. Its cleanliness is impaired by carelessness in handling, and sometimes by fraudulent additions, so that a 5 per cent. allowance for seeds and earth is made upon its parcels. Considering that the grain has been sometimes grown as a mixed crop, and always trodden out of the ear upon a mud threshing-floor, and stored in pits to protect it from weevils, its condition need occasion no surprise. Elevators are unknown to the natives and their grain is never graded, so that under these circumstances it

has many disadvantages as compared with first-class American exports.

Indian wheat is to be regarded as the product of two contrasted factors—uncivilised production combined with civilised distribution. It is grown as a savage grows grain, except where irrigation is employed, for the land is scratched instead of ploughed, the grain is sown, tended, and reaped by hand, threshed without machinery, as corn was threshed in the days of Moses, stored as it was stored in Egypt long before the Pharoahs, and conveyed from the farm in rude waggons, often with wheels of solid wood, as simple in construction as the chariots of Homer's heroes. Whenever it reaches the railway station it passes into the hands of civilised man, to be sold by telegraph, and transmitted by steam over land and sea to its place of destination. Owing to the comparative valuelessness of labour and land in India it is cheap, and therefore becomes a dangerous rival in markets where white farmers sell their produce. It is difficult to find a standard of cost from which to determine its minimum price. The home market in India is readily supplied. This grain is grown for export, and is sold for what it will fetch, so that the great bulk of the price is made up of the cost of carriage. Sea freights are low, and the chief item is the railway charge. Panjabi wheat is most of it shipped at Karachi, after a run of 800 miles from Lahore. The North-west grain is carried from Cawnpore to Bombay, a distance of about 1,000 miles, for less than 1s. per bushel. Freights thence to London have been as low as 12s. 6d., and as high as 25s. a ton, though the average lies between 16s. and 20s. The average railway rate for long distances would be about ½d. per ton per mile, so that the quarter bought in Oudh for 11s. 9d. is landed in London at a little under 32s. This gives a farmer's price of less than 1s. 6d. per bushel, as against 1s. 9d., the lowest recorded in America. Though the freights and rates from the States have been halved since 1872, it would be unreasonable to expect anything like the same reduction in the future. It now costs two bushels of wheat to get the third bushel from Nebraska to London. Any future reductions are likely to be in farm prices. The Indian ryot may even afford to take less than 1s. 6d. a bushel for his grain, but can the American or the Australian?

The problem is greatly complicated at present by the silver question. This affects Indian production, because, while for purposes of internal exchange the rupee counts still for 2s., and still buys labour, land, food, and wheat to that amount in the country, its price abroad has varied from under 1s. 6d. to 1s. 9d., so that for the lower sum the English merchant gets 2s. worth of Indian wheat. To a certain extent, the Russian rouble, also of silver, is similarly affected, but the United States, immense producers of silver, and having a silver coinage, are considered to suffer, because the dollar, unlike the rupee, has a diminished purchasing power in its own country. It is at least remarkable that through all the variations of prices of the last decade the relative values of silver and wheat have always risen or fallen together. Australia is also a sufferer, for

the cheapness of silver in the meantime operates as a bonus to Indian production generally, and especially to wheat. Besides this handicap the irrigation systems impart a certainty to agriculture which enables the ryot to accept lower prices than if he had to add the losses occasioned by a failure every third or fifth year, and the fact that he grows his food and earns his rent mainly by other crops at another season operates in the same direction. Altogether he is a competitor worth watching, and if, as appears possible, he ever raises his area under wheat to 40,000,000 acres, and continues to increase it to 50,000,000, the British Government providing him with railways and irrigation works, he will probably surpass all other exporters to Europe, except the United States, in quantity, though judging by his habits he is unlikely to produce best qualities, or take top prices.

There are still 80,000,000 acres returned as arable, but uncultivated, in India. A considerable portion of this enormous tract will need irrigation to render it productive, and, as we have seen, an increase of 5,000,000 acres in the regularly watered area is as much as can be at present looked for. The additions to dry farming can only be roughly conjectured, though as they depend upon railway extension and migrations, which are never willingly undertaken by the conservative cultivators, it is certain that these also will be gradual. Summing up the prospects, and taking wet and dry farming together, there ought not to be an increase of the wheat export by more than 30 per cent. in the next fifteen years. Its cheapness is to some extent balanced by the higher quality of the Australian product, which will always ensure it a higher price. But what is certain is that the low figure at which the ryots' grain can be placed upon the markets of England, is likely to permanently cripple British agriculture, and that the large margin of untilled Indian land, open for settlement, offers the opportunity for an indefinite though deliberate increase of its exports, which must depress European prices, and discourage white competitors.

The Australian farmer may well ponder the situation at once, and inquire whether it is likely to be profitable to compete with a producer who can take 1s. 6d. a bushel and even less for his grain. To supply the wants of our own continent, and to have a surplus available so as to be able to take advantage of a good demand abroad, is no doubt the wisest colonial policy. Not that wheat growing could or should be restricted at once, for the progress of the Hindus will be slow under any circumstances, while a rise in silver, or a war in Asia, might at any moment alter the whole situation. Still, so far as their neglect of civilised standards is concerned, the Russian peasant or the grower in Asia Minor are rivals of the same class, against whom it is almost hopeless for Caucasians on this side of the world to compete. The very size of the export business of the States, and their proximity to the old world, gives them great advantages as against us. Instead of pitting ourselves against such odds, it would undoubtedly be judicious to steadily shift the balance of our cultivation, so as to make the most of the

special advantages of position which we possess and they do not. In these only the South American States can hope to challenge our supremacy, and, judging by their recent history, they are not likely to do so for some time to come. The contrast in the seasons of the southern hemisphere gives us our great and singular superiority. It ought to secure for our farmers a practical monopoly of the markets for dairy products, fresh fruits, and even vegetables in Europe, and Eastern America, at certain times of the year. High prices reign then, and there are absolutely no rivals to be faced. Our people have only themselves to thank if they persist in putting their whole strength into a starvation race with Russians and Hindus, to produce wheat at low prices, while they neglect high-priced products, which the rapid improvements in cool chambers, and in speed of transit, enables them to place upon the northern market in first-class condition. With the cash received from their wheat they can now, if they will, start the creameries, factories, orchards, and canneries, which ought to pay them far better, and by means of irrigation where the seasons are too dry, or the rainfall is uncertain, pay them more regularly than wheat growing as a sole product ever has done, or ever can do. The secret of success for the Australian farmer will be to develop his holding so as to be able, like the ryot, to regard wheat as an extra, and sell it for what it will fetch, without impairing the ordinary income of his farm. This should be derived from spring products grown to meet the demand of the winter markets of the old world. Nature will then be upon our side, and the contest will be with those of our own colour in the markets of our own race.

The last point to be considered in this connection is the prospect of commercial exchange between India and Australia: a question which should be of special interest to those colonial farmers, who are already looking abroad for markets. As yet it must be admitted that the trade between us has been of comparatively little value; art wares on the one side, and perhaps a little saddlery on the other, almost completing the industrial total.

What exchange there is at present is chiefly of rural products, and it is in this direction that there are the best opportunities.

The irrigated fields of India are not likely to increase its exports to Australia. In 1889 Victoria took 24,390 cwt. of wheat from Bombay, but the chief purchases are rice, bags, tea, jute, castor-oil, yams, coffee, with pepper, spices, and tapioca, from Further India and the Malay Peninsula. Rice and jute are practically the only products of watered fields which we consume, and neither appears to promise a sufficient return to justify its cultivation here, where climatic conditions would permit. Our exports to India are even less agricultural, gold, specie, and horses, completing the list. In 1889 we bought £375,000, and sold £420,000 worth of goods. Out of this, the horse trade alone is of any value to the country districts. Considering our nearness to India, and the fact that our chief European mail lines touch at Ceylon, the fact that our trade amounts to less than £800,000 annually is rather remarkable.

It would be unreasonable to anticipate that we should be able to compete in Bombay with English manufactures, but it does appear extraordinary that we do not take advantage of our seasons to send orchard and other products just across the line. Mr. D. Wilson, the able and indefatigable dairy expert, sent three tins of factory butter through the tropics in my cabin, which were tested in Ceylon about one month, in Lahore and Calcutta about two months, after my departure. The first tin was opened by Mr. Ferguson, editor of the *Ceylon Observer*, whose verdict was that the sample was equal to Danish or Normandy; that he had seldom tasted better, and that it might be taken for fresh. The second was stated by the editor of the *Civil and Military Gazette* to be excellent, "quite up to the standard of tinned Danish butter." The third tin was noticed to be palpably defective before being opened—a circumstance that need occasion no surprise since it had been subject to very harsh treatment during a railway journey of over 3,000 miles in addition to its sea voyage. Mr. Blechynden, the Secretary of the Agricultural and Horticultural Society of India, whose headquarters are in Calcutta, opened it before his committee and found the contents quite spoiled.

The remains were afterwards made into capital "Ghi." This native substitute is really butter, boiled and clarified in a liquid state; it is solely employed by the Hindus for all purposes, and largely by Europeans in cookery. It keeps well, but is too tallowy in taste for the palates of white men. When made from buffalo milk it is richer in cream, and stronger in flavour, than if from the cow. At least one attempt was made in Victoria to produce "Ghi" for export to India, but the experiment was not attended with success. For one thing the caste difficulty has to be surmounted, since though the average Hindu will cheerfully sell to his brethren a compound defiled by the introduction of beef fat, he will not peril his own salvation by eating it, and the mere fact that butter has been made by European hands is enough of itself to absolutely prohibit it to the pious. Ghi fetches from 9d. to 1s. a pound, but owing to caste prejudices, and the difficulty of hitting the native taste, this enormous market is probably closed to Australian enterprise.

Anglo Indians alone consume butter, and it is to supply their tables that the dairy farmers of the colonies might well devote some attention. It is true that the European population is small, but it can afford to pay for a good article, and my own experience indicates that the climatic conditions are by no means unconquerable. Good Danish butter kept in ice, and invariably used in tent life, sometimes fetches 3s. a pound in the interior in summer, when a native butter can be had for 1s. Calcutta, Bombay, and Madras, are badly supplied with a local product at all seasons, the better quality being usually found up country, and the best, curiously enough, at Kurachi. There should always be a good but limited market, in these capitals, for the best quality butter, carried in refrigerating chambers, and sold at a high price. There should be a large market for

a fair butter of even grade, if once our purchasers could obtain an entrance into the Commissariat Department, and supply the large quantities needed for the troops. In this direction there is distinctly a most promising opportunity.

The export might be supplemented to some extent by supplies of milk—always thin and poor in India—for if the concentrated milk, now growing in favour, could be transmitted with sufficient frequency in cool chambers it would be heartily welcomed by well-to-do whites. There appears to be some prospect of obtaining custom from the army also, as Brigade-Surgeon Hamilton and other medical authorities have strongly condemned the present system of barrack victualling. A "milk and butter supply" branch of the commissariat has been suggested, the medical officer named having estimated that the cost to the State of enteric fever cases, many of which are attributed to infected milk and butter, in the three regiments stationed at Lucknow, has amounted in five years to £30,000. The price paid for hospital milk by contract with the natives is 5d. per quart, and though no doubt any project for supplying concentrated milk in quantity to India, implies an immense advance on our present methods of preserving and transmitting it, the demand is worth keeping in mind.

The fact that the great centres of white population are practically on the seaboard, must be taken into account in all these matters. With cool storage provided in them, it should be easy to initiate a business in fruit and vegetables. It is probable that the prices paid for good table vegetables in the hot season would more than make up the cost of transit. The potatoes obtainable seem specially poor, English fruits are everywhere stale and tasteless, and though they are beginning to be grown under the Himalayas, in the Kulu Valley, and the Kangra district, there is no extensive local production. Peaches and similar fruits thrive at Peshawur, and the Panjab derives a certain supply from the north, but the coasts and the south would doubtless greedily receive a small, steady, and first-class supply, as luxuries. Bacon, ham, and preserved meats, might be almost a monopoly for Australia. The army requirements alone should demand a constant output. Chilled meat for the tables of white residents ought to command high rates, as its flavour would far surpass anything at present obtainable even in winter. In fine, the wants of the white population in dairy produce, fruit, fresh and preserved meats, could be met most readily from Australia, and though the trade would have narrow limits, ought to prove remunerative to our farmers and their agents. Considering that we are but a fortnight distant, and that the country lies upon our main steamship routes, it is somewhat surprising that our exchange is so backward. We need Indian tea, coffee, rice, and jute, and can return from farms and orchards, as well as from mines and stations, what our kinsmen want. The native population we are scarcely likely to attract, though there is a great business to be done with them if their caste taboo was once set aside.

If the principle of encouragement to Imperial trade finds favour

in London, there could certainly be no better opportunity for its application than in the purchases made by the Commissariat of India, which are wholly under the control of its Government. A new commerce could be opened up with the colonies by the India Office without tariff alterations, or legislation of any kind. It is for the Australian producer to prove his capacity to supply the necessaries of white troops, cheaply and of good quality, and he can then command this market in the long run with or without special assistance.

CHAPTER XII.

IRRIGATION GENERALLY.

The first use of irrigation, probably in the form of natural inundation is unquestionably remote in time. Mr. Buckle's *à priori* argument as to the influence of the environment upon each particular civilisation, led him to select India as a chief illustration of his theory, and to trace its redundant population, unequal distribution of wealth and power, caste system, and despotic government, to the physical conditions which made rice and millets its popular foods. Since the first of these can rarely be grown without flooding, he might legitimately have taken another step backwards, and have given to irrigation the priority and influence which belong to it in certain climates. It is the chief means of maintaining the teeming life of Southern Asia, in countries where even to-day the individual is lost in the caste, and race itself appears depersonalised.

There is, however, more than sufficient evidence to enable us to dispense with such inferences. The antiquity of irrigation is manifest since it is found in operation among the first nations of whom any record survives. Nature herself may be held to have taught the Egyptians its marvellous possibilities. The Babylonians were their apt pupils; the great plain of the Euphrates by its means maintained a vast population, and to-day its dreary desolation is marked by the ruins of ancient canals. The practice of irrigation in India, and in China, antedates the historical epoch by an indeterminate period. The Greek Magasthenes, ambassador of Seleukos Nikator at the court of Sandrokothos, near Patna, who wrote an account of India 300 years before Christ, says that then "the whole country was under irrigation," and very prosperous because of the double harvests, which by its means the people were enabled to reap each year. There are reservoirs in Ceylon and in Southern India more than 2,000 years old. The Spaniards on their first entrance into Mexico and Peru, found elaborate provision for artificial water supplies which had been employed for many generations, and the origin of which was almost lost even to tradition.

This antique aid to husbandry, found among many peoples and in many parts of the world before the beginning of the years of history, has had a new spirit breathed into it by modern engineering. Its first successes were achieved in Northern Italy during

mediæval times and some of these are claimed to have been achieved by the universal genius of Leonardo de Vinci. It has been during the last half of the present century, however, that it has made the most remarkable advance. In Italy a number of canals, notably the Cavour, costing over £2,000,000, the Villoressi, costing £450,000, the Casale and the Quintino Sella have been constructed, while in France the Marseilles, costing £1,600,000, the Verdun, £850,000, the St. Martery, and Bourne, are among the chief works which have enormously increased the area supplied with water during this period. Within the last year or two Sir Scott Moncrieff has been enabled to put the Nile Barrage in working order, to the great gain of Egyptian agriculture. In the United States there has been an even more astonishing development, and while twenty-five years ago irrigation was regarded as a primitive Indian and Mexican practice, there are to-day tens of millions of dollars invested in land supplied with works for watering it, in a number of the newest States by energetic and enterprising Anglo-Saxons. In fine, to the thoughtful observer, there is no development of agricultural production in the nineteenth century, so striking in the rapidity of its growth, or in the richness of its returns, as that by means of irrigation. Those who endeavour to discourage its adoption in Australia, who indulge in pessimistic predictions of disaster and seek to belittle what has been already done, should become better acquainted with the progress which it is making abroad.

The expansion of irrigation in India has been much greater of recent years than in any country, except perhaps the United States. The physical conditions of climate and product which, according to Buckle, govern its social and political destinies, have certainly been paramount in dictating this development. The gigantic works undertaken by the Indian Government, and those on a smaller scale reconstructed in Ceylon, were not a speculation in beneficence, but were forced on by the terrible famines which periodically visit portions of this great territory. In every instance these are occasioned by a deficient rainfall, and sometimes the deficiency endures for two or three consecutive years. The population of the continent is so vast, and presses so closely upon the margin of subsistence, that any falling off in the annual food supply is felt at once, and severely. The ryots, or farmers, are able with difficulty to tide over one bad year, two place them in the greatest straits, and three involve wholesale starvation. Insufficiently nourished, even in the best seasons, the helpless villagers perish by hundreds of thousands at the first keen pinch of absolute want. All India, with the exception of a strip along the Malabar coast, and another belt stretching southward from Assam, and including the head of the Bay of Bengal, is liable to failure of rain, and therefore liable to these catastrophes. The British-India steamer which conveyed me from Colombo to Tuticorin discharged 250 tons of Bengal rice at the latter port, in order to meet a dearth in the neighbouring district of Tinnevelly. Almost every year witnesses a stress of want in one or more parts of the peninsula, and it is fortunate when

this can be coped with out of the superabundance obtained in more favoured districts. It is under this horrible pressure of human suffering that the English Government in India has adopted the policy of constructing irrigation works and railways with loan money. They first provide food with certainty every year, while railroads enable their surplus to be conveyed to the starving. Under the many unlikenesses which separate India from Australia we may recognise a strong likeness here both as regards the cause and the condition of irrigation enterprises which have been forced upon our attention by the water famines which have cost the lives of millions of sheep and cattle, and the fortunes of thousands of farmers. Both communities have come to the conclusion that it is judicious to pledge the credit of the country, for the funds requisite to mitigate, if not to prevent, further losses of this appalling character in the future. As the need was keener in India, and discovered earlier, it is not surprising that its achievements dwarf, not only those of Australia, but those of the rest of the old World.

The immediate relation between famine and irrigation is perfectly evident in every presidency. The dearth in Madras in the early part of the present century lead to the construction of the anicuts which supply its deltas; that of 1837-38 in Bengal induced the preparation of the project for the Ganges Canal; that of 1859-60 in the North-West Provinces determined the State to undertake all future works, so that in 1867-68 Lord Lawrence definitely inaugurated what is known as the policy of Extraordinary Public Works. Altogether there were seven severe famines in Southern India in the first seventy years of this century, all disastrous within varying limits. The terrible famine of 1876-77-78, for which a large relief fund was generously raised throughout Australia, marked the culmination of these awful visitations, 5,250,000 persons dying in the lingering agonies of starvation, although the Government lavished £11,000,000 in relief. The indirect losses occasioned would render this hideous total more imposing still. It was evident that to cope with evils of this magnitude the preventive measures must be upon a similar scale, and in spite of the fact that India has had to bear the cost of three wars and a portion of the cost of a fourth since that date, her rulers have devoted themselves to the task with a courage and energy which are worthy of the occasion. If the British in India had achieved nothing else, the public works policy of the past twenty-five years would fully justify their supremacy.

Prior to 1854 all irrigation works were constructed under a military board by military engineers, and paid for out of revenue as part of the ordinary service of each year. It is difficult, if not impossible, to ascertain the exact outlay upon particular schemes, or indeed upon the whole of them up to that time. Broadly the expenditure of loan money now exceeds £33,000,000, reckoning the rupee at 2s., and taken as a whole the works pay interest on that sum. The original estimate was that only £30,000,000 would be required, but since then new schemes have been ordered, some of

them authorised, and some are at present in course of construction. The railways have had nearly eight times as much money invested in them, either by the State or upon its guarantee, and though they are now paying 5 per cent. interest upon the capital sunk in their construction, have £39,000,000 to make up if they are to recoup the losses of earlier years. The situation in India from the financial standpoint merits the consideration of Australians, since the colonies have embarked upon a similar policy, and most of them are likely to push it further in the future.

The one Australian colony which has commenced to encourage irrigation is Victoria whose watered area was 5,000 acres in 1889, and reached 25,000 acres in the following year, which happened to be dry. This is less than in the little Indian State of Ajmere, and less than the vineyards and orchards around Fresno in Southern California. It will be many years before Australia as a whole can hope to rival the smallest of the Presidencies, or the least progressive of the irrigating States in Western America.

The statistics available are as yet partial, sometimes conflicting, and require to be taken with that knowledge. So far as can be determined, the position is as follows in 1890:—

Victoria	25,000	acres irrigated.
Ceylon	100,000	,, ,,
France	400,000	,, ,,
Spain	700,000	,, ,,
Italy	3,750,000	,, ,,
Egypt	5,000,000	,, ,,
United States	7,500,000	,, ,,
India	30,000,000	,, ,,

It is doubtful if the acreage calculated for the United States can be unreservedly accepted. It probably includes large areas commanded and capable of being watered. The Senate committee look forward to a time when 100,000,000 acres will be irrigated in the United States, by people of the same stock as ourselves, who live under conditions closely resembling our own. With these figures before us, can it be said that Victoria or Australia has exhibited any undue haste in fostering this enterprise?

In India cultivation and irrigation are both upon the greatest scale. Its agriculturists vastly more than equal in number the whole population of Canada, the United States, and Mexico, added together, while those who live by irrigation are more in numbers than the whole of the farmers and farm labourers of the same countries engaged in wet and dry farming together. India has four times as large an area irrigated as there is irrigated in North America; its canals exceed all others in length and capacity; its methods and its products are more varied; its yield more valuable than that harvested in any other country, and India thus maintains a denser population than any equal tract of the earth's surface of which we have trustworthy information. In every aspect, therefore, it may be entitled the first irrigation country in the world.

What then can it teach us? Viewing the subject in its most general aspect, irrigation may be broadly divided into two parts: the work of the engineer who makes water available, and of the cultivator who employs it upon his fields. To succeed with his project the designing officer requires some knowledge of the cultivation to which he ministers, and the farmer some knowledge of rudimentary hydraulics to govern his water when he gets it. The title "agricultural engineering" has been applied to the task of the professional man, and that of "engineering agriculture" might be adopted with little less appropriateness to the farmer's share of the work. That there is an art of irrigation is evident upon the most cursory observation of its practices in any part of the world. The conditions under which water should be artificially applied need to be varied with judgment, chosen with nicety, and determined by a knowledge, at once comprehensive and accurate, of all the factors of the case. There are some general rules of universal applicability to irrigation everywhere, but they are relatively few and vague. The solution needs to be worked out in each separate instance, just as every customer's account must be made out by itself in a tradesman's books. What amount of water should be given, in how many instalments, and at what junctures, depends *inter alia* upon crop, soil, climate, rainfall, the season, and the particular quality of the product which it is desired to develop to make it most marketable. What light, it will be asked, does Indian experience cast upon these issues so far as they are likely to face the Australian farmer?

To visitors who have had no previous acquaintance with irrigation, the ryot might teach a great deal, but he has little to impart to those who have added to some practical experience in the colonies a general knowledge of American and Continental practices. The lessons of the danger of over-watering, of the necessity for adequate drainage, of the value of unremitting cultivation, fallowing, fertilising, and rotation of crops, all of which might be acquired in the Panjab, will bear much repetition and continuous illustration, but it cannot be claimed that, except by way of reinforcing previous lessons, there is much else to be learned from a study of Hindu farming. There is a possibility that to the general reader the reiteration of warnings on these heads may have become trite and commonplace, but nevertheless, the manner in which writers for agricultural journals still find it necessary to repeat them, is an evidence that, often as attention has been called to them, these simple principles are still ignored in many countries. They are not yet universally mastered in India. In all newly watered districts, in all presidencies, crops can be seen which have been impaired or destroyed by untimely and excessive soaking. In some older districts patches of snow white reh, or deserted stretches of sodden and marshy land, growing only coarse reedy grass or semi-aquatic plants, tell their own tale of neglected drainage. The surprise felt that crops are as good as one sees them to be in the North-West Provinces is lessened when one notes that every weed has been scrupulously removed by hand, and the ground as carefully gone over as if it

were a kitchen garden; that the plot is only cultivated once in three years, often ploughed while lying fallow, enriched so far as the owner's means will allow, and a certain traditional round of cropping strictly observed. So far as the cultivators succeed, it is because they obey those fundamental principles of agriculture which are true everywhere, applicable with but minor modifications in every country under the sun, and not in any way peculiar to the great Asiatic peninsula.

Between the Hindu and the European there is always, and in everything, a great gulf fixed. This is true even in regard to the minutiæ of irrigation. Uncommunicative, or mendacious, to the stranger who speaks his language, and distrustful of the Government officer who is almost the only white he sees, only a portion of whatever knowledge there may be in the native farmer finds its way into print. Still, revenue collectors and assessors, assisted by the agricultural and irrigation departments, attain an insight into his practices and their results, which is sufficient for all practical purposes. Indeed, very little observation is required to give a fair acquaintance with the methods employed in the little holdings, from which many millions wring their bread, or to assure the inquirer that there is nothing esoteric in the tillage and watering practised north or south.

Many fairly competent critics consider the Hindu an expert irrigator in districts in which the practice is more than thirty years old, as well as a competent farmer, and this is undoubtedly true, if the one great qualification be added, that the expertness is the best attainable by a labourer without capital, implements, or machinery. Remembering the part that these play in modern farming, the severity of the limitation imposed by their exclusion will be rightly estimated. A moment's reflection will show how unreasonable it would be to cherish large expectations of enlightenment in the art of irrigation at the hands of the varied Hindu races in their several stages of civilisation, who, whatever their intellectual achievements in other spheres and in other ages, have never paid attention to the applied sciences, and have remained from the days of Manu down to the present time, dependent upon an agriculture which is but one remove from savagery. The Aztecs under Montezuma were, and the Red Indians of the Southern States of Western America, or the Fijians and Samoans in the South Seas are, as advanced in their systems of cultivation as the bulk of the Hindus to-day. With a philosophy that has amazed Europe, a poetry that has outshone that of all Asiatic peoples except the Hebrew, an architecture without a rival in its own style, and hand-loom manufactures whose quality surpasses that of the finest machinery in the best factories in the world, its farming has remained in an Egyptian stage, and in Egyptian darkness, so far as modern science or modern implements are concerned. In the refinements of metaphysics, the Hindus forestalled the nineteenth century, while in their agriculture they have remained in the condition of primitive man.

Squatted upon his hams, clad in a waistcloth, and often without

vest or turban, the Hindu peasant bends above his irrigating channel, and repairs its breaches with deft and even hand. The many channels which diverge from the hole out of which he either bales his water, or, if it be deeper, raises it by a pole and counterpoise, or draws it by bullocks, are often built up a foot or 18 inches, and sometimes more, out of the stiff soil. Upon these narrow ridges little rills of water are carried to all parts of the field. The whole of them appear to have been built by the almost unassisted hand, as urchins make mud pies. The tool for directing the water is but a piece of stick, and thus the whole of the watering is provided and managed by the ryot's palms and fingers and those of his wife and family. The burned, sharp-pointed staff and cross branch, which compose his plough, with an old dish-shaped basket or two for removing the soil, and a chopping hoe, comprise the whole of his working plant for cultivation and irrigation. He will stand up to his knees in water all day among his rice fields, and toil the whole twelve months through for a bare subsistence, but he will be very loth to try a new experiment, will never make a purchase, except on extremity, either of an improved seed or implement, and will cling to traditional ways so long as he can find the slightest pretext for justifying them. There is but one word for his style of work, and that is "slovenly." His dams of stakes and rice-straw generally leak, and occasionally give way, but he will probably build the next on exactly the same plan, and there is never any attempt at finish in any of his contrivances. The hardness of his lot and the meagreness of his opportunities no doubt largely account for these failings, but certainly the same conditions prevent him from idleness. He almost lives in his fields, will cheerfully receive and distribute his share of water all night, if need be, will watch the trickling supply with inexhaustible patience, and guide it with a dexterity born of long experience. Here his part in the irrigation begins and ends. Whence and how the supply came to him, or where his drainage will flow are matters in which he exhibits not the faintest concern. A timid, industrious, inoffensive, domestic, gossiping hind, he exists mentally in as narrow a plot as that upon which he works; his little horizon everywhere bounded by extravagant legend, absurd superstition, and implacable fears. Living in abject poverty, material and intellectual, the little cunning he has acquired in dealing with his crops pertains solely to the state of nature in which he lives and works.

Except in the spring harvests of the north, the products of India are not those of Australia. It is not therefore to such a school that our farmers are likely to look for lessons in field irrigation. For that, now and always, until our own experiences are completely organised, we shall look eastward to our countrymen on the great inner uplands of the Rockies and prairies beyond, and on the lowlands nearer the Pacific, fed by streams from the Sierras. The alert, inquisitive, intelligent, restlessly inventive and progressive Americans, multiplying their machines and devices every year, bringing to their aid all the resources of scientific discovery, and to their

management the keenest commercial spirit, are likely to be our masters in this regard for a long time to come. The stalwart men, high booted, Garibaldi shirted, with wide-brimmed hat and long-handled spade, independent, upright, courageous, thoughtful, self-reliant, and well-mannered, who may be seen in the orange groves of Los Angeles or Pasadena, are of a type to which we may turn with confidence, and which we may hope to acclimatise on our own shores. The Hindu who irrigates is comparatively about 2,000 years in the rear.

In the other branch of irrigation, which includes the construction and maintenance of main works, India is as much in advance, as she is behind in its agricultural application. The student of hydraulics will look in vain for her rival, save in schemes of town supply, where the great cities of the Union, and especially New York, have grappled with colossal undertakings. The irrigation engineering of the United States is child's play so far, when measured with that of even the least successful of the presidencies, with the single exception of the Bear Valley system, in California, now commanding 20,000 acres, but intended when completed to water 500,000 acres, from a reservoir nearly twice as large as the proposed Waranga storage. The Italian canals are now most admirably designed and efficiently managed, but cannot bear the comparison any more than the American. Egypt has still the largest canal, and in the Barrage perhaps the largest single structure of a high type, but for all that is surpassed in both size and quality of works by the Panjab, the North-West Provinces, and Madras. India has run the whole gamut of irrigation works, and is therefore incomparably superior, as an engineering school in connection with irrigation, to any country in the world. The colonies as yet can show nothing to compare with any of its schemes. Taking Bombay alone our Yan Yean or Prospect embankments are dwarfed by that at Ekruk, not to mention a recent famine relief work at Almella, where an earthen dam has been built 90 feet high, and 2 miles long, to carry 80 feet of water, with an escape over a rocky ridge 4 miles distant; while the Goulburn weir, great and massive as it is, would scarcely make a section of either Khadakvasla or Tansa. It will be many years before Australasia altogether can show as many acres irrigated as does that one strip of Western India.

Every variety of major and minor hydraulic structure is to be found somewhere in India, almost every river and storage difficulty has been faced, all classes of soil worked upon, and the dangers of damage in flood or loss in soakage alike confronted. There is a body of experience in works not yet put into type, but which if described and interpreted by competent critics, would furnish a far more exhaustive treatise on irrigation engineering than any now in existence. These pages, written by a layman, make no pretension to attempt this task. They merely indicate that it exists, and sketch, in a popular way, some of the more striking features of one of the greatest enterprises that the British Government has undertaken in any part of the world. The

admirable book by Baird Smith, now thirty years old, Mr. Buckley's summary, ten years old, a most interesting paper by Mr. Brereton, of the same date, Jackson's compilations, five years old, a remarkably comprehensive essay by Mr. J. T. Boase, read before the Victorian Irrigation Conference of last year, and Mr. Nicholls's graphic little treatise, comprise the literature upon a subject, partially dealt with no doubt by Sir George Chesney and General Strachey in a general way, but nowhere even roughly outlined in its past history or present development. It is worthy of the amplest and most elaborate study in all aspects and in all details. What is needed is a succinct history of each scheme, describing and explaining all its failures and all its successes, and depicting its present condition in a clear and forcible way. These should then be grouped into systems, their likenesses and differences noted, and the principles which they illustrate set forth, so that even laymen might read and understand, while professional men would acquire fresh evidence and suggestions for new developments of their work. An opportunity remains for the writing, by a competent literary man and engineer, of a book which would be a manual of construction for many years to come, of the greatest value to the colonies. If complete, it would at the same time offer to the outer world, the best justification for British supremacy in India, and the best evidence, from facts and actions, of the large minded generosity and courage of its rule.

It is comforting to note that the adverse conditions which obtain in Australia have not proved an insurmountable barrier to success where they have been met with in India. The Goulburn has been curbed, and the Loddon likewise, by our own engineers, some of whom have had experience in the Presidencies, and there is nothing disquieting in the prospect that the Commonwealth may some day undertake the locking of the Murray, and the Darling, or that diversions will be sought from the Clarence, Richmond, or Nepean. A skill which has dealt with the Ganges, the Indus, and their tributaries will certainly suffice to control the wildest of our streams. The absence of foundations, and the presence of treacherous banks, have been overcome by our own countrymen in Asia upon torrents whose floods descend with tropical rapidity and violence, and in country to which materials had to be brought by long railway journeys. So far, the efforts to obtain an artesian supply have proved as fruitless as those of Victoria. Canals have been carried for distances as great as any which we shall require to construct, through districts where climate and characteristics have been most unfavourable for cheap or expeditious work. The surface canals, much favoured by the late Mr. M'Coll, and the possibility of the maintenance of which was denied by his critics, were in existence within twenty days' journey of us all the time. Large bodies of water have been carried in channels whose bed consisted of the natural surface of the ground, untouched except where ploughed under the banks, which were made from soil obtained by parallel excavations on each side, just on the plan he favoured. But

further than this, canals of great size have been made and maintained upon the crest of artificial banks on precisely the lines adopted by Mr. Stuart Murray. It is true that neither of these expedients is employed except in cases of necessity, but the same statement is true of every other type of construction. Indian experience is wide, and its devices are numerous; no one of its schemes exactly resembles another, and even the best of its works would require amendment before it would be perfectly adapted to Australian use. Not only can India furnish us with models, but also with the knowledge of how to use and vary them, though this is not yet as ready to hand in print as it might be. To unravel all the conditions of the works would occupy a long time; the most prominent and obvious have been outlined in a casual way already. It is needless to recapitulate the inferences to be drawn from them, for they have been indicated as far as possible from time to time. The cardinal conclusion to be drawn by way of summary is that they afford general solutions of all the difficulties of construction which we are likely to encounter in these colonies. By their light our professional men should be able to store, divert, and convey our water supplies with the maximum of safety, and the minimum of outlay.

The question of cost does not admit of comparison, for whether in field work, in the execution of a scheme, or its maintenance, the cheap labour of India affects it at every turn. Not that the gain is as great as it looks; the superior skill, energy, and intelligence of the white labourer contributing a formidable element of value on the other side; but nevertheless the inexpensiveness of both earthwork and masonry makes itself felt in all the totals. Against the low wages of the tribes of minor officials connected with each scheme as watchmen, measurers, and overseers, has to be set the doubt always entertained as to their honesty and impartiality. For purely mechanical duties, where they are easily checked or supervised, Hindu employés are not only cheap, they are highly efficient; but in all cases in which judgment is required, or trust reposed, they are far from satisfactory. There must have been men of engineering talent among them, though of course wanting in experience. At Bijapur a weir, half a mile long and 80 feet high at the centre, has recently been discovered, apparently silted up for want of an escape, a fertile cause of failure in many ancient works, from the inundation canals of the Panjab to the tanks of Mysore.

Native workmen build, native officials maintain, and native cultivators use all Indian canals, so that the irrigation enterprise, like everything else in the country, appears purely native, although designed, executed, and governed by the white, and maintained under his eye. Its difficulties are largely native also. Forests are leased from rajahs, who are ever ready with complaints as to their receipts, or, if they take water, about drainage or the insufficiency of the supply. The native management is, as we have seen, also unreliable. Thus in every way the cheapness of labour is discounted by the disadvantages consequent upon the fact that for

the construction, administration, and revenue all Indian canals are dependent upon natives.

These are the general considerations preliminary to any survey of the Indian irrigation, a complete study of which would richly repay those charged with the administration of the Empire, whether in England or in the country itself, since its importance is properly appreciated in neither.

A large volume could be written upon the practical, scientific, and commercial phases of the question, for the few sufficiently interested to follow them into all their details. What is attempted here is to offer a sketch, hasty and rude, which may be of some service in any consideration of the Australian future of water supply. To illustrate the size and character of the Indian works, and their dependent interests, blue books have been freely drawn upon, and personal investigations employed to interpret them, with the result that the information collected and collated is probably new to many in India, and to all outside it, except a few retired officers of its departments. Condensed from many sources, unravelled from conflicting or incomplete reports, and mainly composed at a distance from the country, this work necessarily lacks the value and interest that would attach to a more capable and minute treatment of the several provinces and their schemes. As it is, the facts and figures will probably prove repellent to the casual reader, though it is hoped that the summaries given, bald as they are, may not be without importance to those directly concerned in irrigation developments. This in a sense includes our whole population, for the question is one that must be dealt with in the Australian Parliaments, and it is a matter of extreme moment that our representatives should be familiar with the history of the successes and failures of British engineers in similar enterprises.

The Australian elector nowadays is a member of a court of appeal to which all kinds of questions are remitted for decision; irrigation expenditure will be discussed many a time during the next twenty or thirty years, and it therefore becomes a subject of which a certain knowledge is bound to be of use. The value of this book is of course diminished by the writer's want of technical knowledge, and by the fact, which has affected both its style and substance that its contents made their appearance simultaneously in the columns of the daily and weekly press of the capitals of three colonies. On the general history, finance, position, and prospects of the great Government schemes the succeeding chapters are at least accurate and fairly complete. No publication is known to the writer having the same end in view. His obligations to existing literature are freely acknowledged, and it would afford him unalloyed satisfaction if some better qualified person would devote to the irrigation of India the prolonged investigation and expert exposition which it deserves. The debt of obligation which the country is under to the British Government, and the British Government to its engineers, will otherwise never be known or estimated, as it probably will never be discharged.

The position of the chief irrigation schemes alluded to can be found by reference to the accompanying map. For statistics generally, and for a comprehensive, though rough, outline of what they have done and are doing for the different provinces, those interested are referred to the appendices. A series of typical works will first be passed in review, in order to convey in a less formal manner, to the general reader, some conception of the scale and character of the great hydraulic achievements of our countrymen, and the conclusions to be drawn from their experience. Those who bear in mind the differences of climate and circumstances which exist between the Presidencies, and their component parts, will need no further caution in that regard, although these descriptions of particular enterprises may assist at the same time to impress upon them the divergencies in connection with irrigation, which reflect the physical heterogeneity of the peninsula, warning us once more of contrasts in the capacities, customs, and creeds, of its peoples, that need to be continually recalled to mind.

CHAPTER XIII.

THE KAVERI SCHEME.

The magnitude of the operations of the Irrigation Departments of India compels their critic to deal in digests and summaries, in the endeavour to convey an adequate idea of the scale upon which they cope with the deficiencies of Nature, and supply the wants of one district from the superfluities of distant hills. One must always face a danger in such epitomes that the figures given cease to have a meaning except to men trained to their use in this particular connection. A further difficulty is, that unless he be repeatedly reminded of the local conditions and surroundings of European enterprises in Asia, there is an almost irresistible tendency on the part of the reader to unconsciously substitute as a background the circumstances of his own country, and by the inevitable association of ideas to interpret, more or less consistently, the achievements of which he is given a bare outline by his own experience. He thus insensibly essays to measure them by standards which are only applicable in an Anglo-Saxon community. To obviate this it is necessary to introduce here and there as tersely as possible a few descriptive passages, which may to some extent prevent or mitigate the misconception, by keeping the foreign element in view, and by glimpses of detail suggest a completer conception of the truth. It appears appropriate, therefore, to give a sketch of some tours of inspection, from which the condensations and statistical reviews may be better understood.

The nature of the irrigation works in the Madras Presidency, and their historic development, are best illustrated in the great Kaveri scheme, which supplies a delta stretching from above the town of Trichinopoli to the sea. The chief systems of southern India are all on the east coast, all deltaic, all modern adaptations of ancient designs, and all make river waters available by the same class of works. Any one of them will serve as a key to the rest, and this particular scheme, as the largest and most profitable, is naturally selected to indicate the type.

The town of Trichinopoli, still the second in the Madras Presidency, would probably never have existed but for the great rock rising in its midst 273 feet sheer, and constituting an inland

Gibraltar dominating the whole of its fertile plain. In the wild Maratha country, among the columnar masses of the Western Ghauts, or upon the sterile cliffs of Rajputana, mountain strongholds perched upon almost inaccessible summits are frequent and picturesque. Among the level rice fields of the south such eminences are rare, and wherever the rocky mass rises it is honoured as the seat of a sanctuary, or walled for the purposes of defence. Centuries before the Christian era this town was a seat of sovereignty, and during the struggles of the French and English was the scene of many desperate fights. To save Trichinopoli, Clive marched upon Arcot, and, relieving Trichinopoli, saved southern India. The walls about the base of the rock are gone, but the citadel remains, and high upon the topmost point stands a fine temple. From its platform the eye commands the whole city, the inner courts of its crowded houses, and within them cattle standing patiently; flat roofs, where grain is spread in the sun to dry; wells, where women are drawing water; busy lines of miniature shops, with trains of passing bullock carts; coloured flags fluttering before a house where wedding festivities are in progress; flocks of crows rising and falling, and above them half-a-dozen kites sweeping on the watch for prey. Closely packed lines of huts, narrow lanes with plastered two-story houses, a few large buildings, and an artificial lake, lie around us. Afar is the winding river embracing the long green island of Sriringam, the gopuras of whose temples rise from out an unbroken stretch of palms. On the other side is open country, patches of cultivation, green and fallow fields; a few small hills in a great expanse and a low-lying range on the horizon. Up to the height float the buzz and babble of the bazaar in a confused murmur, an echoing shout, the sound of stringed instruments, and of a bell at the side of an elephant as it makes its diurnal march from the shrine through the town to the river. Swarming near and dwindling far, a copper-coloured crowd scatters itself towards the outskirts. Streaming sunshine from a cloudless sky, the reddish glare of the rock, the town white-walled at its feet, with soft refreshing masses of verdure beyond, belong to winter in Trichinopoli.

It being alleged that the roads are too bad to permit of the passage of an European vehicle, we are driven to the necessity of making our journey in a jodka. The allegation proves to be without a shadow of foundation in fact; the road is perfectly good all the way, as indeed are most roads in India; but as the guide's commission is a few farthings more in the jodka, we are remorselessly doomed to its employment. Natives travel habitually four deep in the body of a toy dog-cart into which only one white could compress himself even painfully, and hence our apprehensions of what is in store for us. The jodka proves to be about the size of a packing case, covered with an arched roof of sugar matting, under which it is necessary to sit embracing one's knees, regarding the landscape across or between them. It is drawn by a pony about the size of a Newfoundland dog, out of sympathy with whom we

walk part of the way. The first animal yoked not unnaturally jibs, but a second, under much insistence, consents to proceed, jolting us in our pen, upon a springless axle, like a couple of calves going to market. We pass between endless fields of paddy, and flowing channels of water, along a road planted for the most part on both sides with shade trees, which, following the river down, brings us at last to its latest headworks.

Indian spelling has submitted to as many revolutions as Indian politics. In the early days men spelt with reckless inaccuracy; to-day they indulge in frigid theories; but there is a fine freedom of selection enjoyed even by public departments, resulting in anarchy of authorities. The Cauvery is still so styled in official plans, while in official publications it is termed Kaveri, a form that may be perhaps as well retained as any other. This important river, draining both the Nilgiri and Anaimailai hills, is fed by both monsoons, and yields a fairly even supply nine months in the year, rising in flood to a discharge of 284,000 cubic feet per second. Its channel is 4,400 feet broad where the island of Sriringam, 17 miles long, divides it into two parts, the larger of which, flowing northward, is known as the Coleroon, while the smaller, retaining the name of Kaveri, divides into a number of branches taking a south-easterly direction. Between the two they supply the large fan-shaped delta of Tanjore. The engineering problems presented are comparatively simple, but the area affected is so great that it is only by means of a complicated series of works that its watering can be guaranteed. It is one of the oldest schemes in India, and has grown to its present shape by successive additions and alterations spread over nearly a century of British rule.

The conception of an irrigation project for Tanjore dates back many hundreds of years, and the execution of the first work for that purpose long preceded any European settlement. The "grand anicut," as it was termed, of native construction, was a weir 1,080 feet long, 40 to 60 feet broad, and 15 to 18 feet high, winding across the Kaveri. In 1804 it was found that the Coleroon, having a more direct course and greater fall, was obtaining all the water, while the Kaveri, upon which irrigation mainly depended, was threatening to become dry. For some time temporary dams were thrown across the Coleroon in order to obviate this, but the result was a dangerous silting up of the bed, not coped with until 1829, when Major Sim proposed the use of under sluices from the Kaveri to the Coleroon. These proved so successful that three sets were introduced. Still the supply to the Coleroon was nearly as great as to the Kaveri, so that Sir Arthur, then Captain Cotton, was authorised in 1835 to erect an anicut on the head of the Coleroon. This proving only too effective a remedy, was lowered in 1843, and in 1845 a weir was built on the Kaveri. In one sense therefore these are the headworks of the scheme. The head of the island of Sriringam is protected by a masonry wall 14 feet high, from which run two masonry weirs (built on a double row of wells and protected by aprons), 2,796 feet long on the

Coleroon, and 1,950 feet long on the Kaveri side. By these the water is divided in the first instance between the two branches. The weirs are covered by bridges, and their total cost to date is something over £25,000. They only raise the water from three feet to seven feet high, but for all that eight arches of one of the bridges were carried away in 1858.

Three miles below this headwork, called the upper anicut, is a masonry escape, like an anicut, standing upon wells built in 1834, and having a waterway of 5,200 cubic feet per second. A bridge was added in 1838. Formerly the grand anicut, which served a similar purpose about 11 miles lower, was some distance from the regulators, which directly governed the diversion for irrigation. These have now been brought to it, and constitute the finest piece of work on the canal. Built in 1883-86, they are modern in design and imposing in appearance. There are three weirs, one on the river itself, and another on each side of it, the right regulating the canal, and the left an escape on the site of the grand anicut, of which nothing remains but a tiny temple dedicated to the monkey god. The Kaveri is spanned by a lofty masonry bridge weir leading from the work, taking the place of the grand anicut, to another of the same type, and almost of the same length as itself, which controls the entrance to the artificial river. The central structure is of granite, resting upon wells, and consists of 14 arches of 37 feet, each of which contains three sluice gates. It is protected by a 15 feet apron above and 30 feet below, having a total width of 609 feet, sustaining a brick bridge 23 feet high. On the right hand side, separated by a protecting bastion, runs at an obtuse angle the Vennar regulator of the same construction, but of 11 main arches only, and with a total width of 483 feet. On the left hand side runs the third structure, the Coleroon escape, a little more separated from the central structure, and at a little less obtuse angle than the Vennar regulator, its under sluices, next to the Kaveri, first placed there in 1830. In 1886-87 the bridge was raised, and the low masonry weir beneath fitted with iron falling shutters, while the sluices were also shuttered and supplied with screw gearing.

These three works between them govern the lower river. The main purpose is to keep a full supply going down the Vennar, upon which a very large area depends for its supply. The Kaveri itself has to feed other channels, and for this purpose requires to have its share. The Coleroon river is not called upon to yield a supply for a considerable distance below this spot, although it, too, has eventually to be studied in this connection. Its main purpose is to serve as an escape down which the annual floods may be allowed to expend themselves harmlessly. In full supply there is a depth of 4·20 feet flowing down the Kaveri and 5·00 feet down the Vennar, while at no time is there permitted to be a greater difference between the water above and below the anicut than 4·50 feet. The flood of 1887 saw 11·87 feet pouring down the Kaveri, and 11·95 feet down the Vennar. A staff of 36

natives remains always at hand to attend to the raising or dropping of the gates. Manage as they may the high river inflicts some damage yearly, although the banks of the river and the Vennar alike are protected by stone revetments for considerable distances. Roughly speaking there are 500,000 acres dependent upon the Kaveri, 400,000 acres upon the Vennar, and 100,000 acres upon the Coleroon. With such interests at stake the greatest vigilance and circumspection are necessary, and there are always one or more responsible officers in charge. The river is from 1,000 to 1,500 feet wide at this part, and when it pours down, its torrent of turbid waters, shallow as they may seem, can be controlled by nothing weaker than granite and iron.

Splendid as these are, they do not conclude the list of important works in this scheme. The Kodamurti regulator has two bridges above a long masonry dam—one of 13 arches of 34 feet and the other an equal length, with sluices substituted in the fifth arch from each end. Again at the Arasillar there are two dams—one 60 feet and the other 150 feet in length, 10 feet high, of solid masonry, without bridges. The same work is repeated at the Verasholen affluent, spanned by an 83 feet weir with a 50 feet weir across the Kaveri. Each of these three works repeats the task of the great Kaveri and Vennar regulators, controlling the river in each case when a stream leaves it, though without an escape such as that over the grand anicut. Finally, on the Coleroon we have the lower anicut, consisting of two masonry dams, that on the north 1,068 feet wide, 8½ feet high, on 3 feet foundations, resting on wells 6 feet deep, with two masonry aprons of 24 feet; that on the south is 7½ feet high, and 1,048 feet wide. They are crossed by bridges of 30 arches 16 feet high. This anicut not only directly waters a considerable extent of country, but supplies the Veeranum tank, which, by means of an embankment 12 miles long, retains 5,400,000,000 cubic feet of water. Such figures as these indicate, though vaguely, the scale upon which this great scheme is constructed and controlled, and the permanent character of the works which are distributed throughout its area.

It would be impossible to decide how far the native engineers of the past have been responsible for the excavation of what now appear to be the natural channels with which the delta is interlaced. These carry the water into every part, and need but short ditches to allow its diversion upon the cultivated fields. The task of British engineers in this connection has been to correct their levels as far as possible, provide against erosion, and ensure their maintenance. If the distributaries had been laid out at once upon a scientific plan they would have certainly proved more efficient, but as it is they fulfil their purpose very well. Before the English took the matter in hand there were 750,000 acres irrigated, producing a revenue now set down at £207,000 a year. It is true that the supply was becoming yearly more precarious and more unsatisfactory, and that under native management—or want of management—it is possible that this return would have dwindled away, unless further works

were undertaken. Nevertheless full credit is given for this amount in departmental accounts. The department credits itself only with the 250,000 extra acres watered since it began its work, and with the £65,000 a year received from them. Yet, even under these restrictions, the figures it presents are formidable. The rainfall of the district ranges from 37 to 47 inches. The cultivable area commanded is 920,000 acres, of which, in two crops, over 1,000,000 acres is supplied annually. The direct water rate is £300,000 a year, and the value of the crops watered £2,289,000. Putting the British capital expended at £178,000, and noting its earnings, we find that this outlay has produced a net accumulated surplus of £1,700,000, and that it pays from 30 per cent. to 45 per cent. profit into the public funds annually. Taking its size into consideration, this may probably be reckoned not only the most profitable, but the most remarkable, scheme in India.

When it appeared possible that the water supply might fail. absolute ruin stared Tanjore and its district in the face. Since the completion of the scheme it is reckoned the richest part of the Presidency, and returns the largest revenue in the empire. Land under the silt-charged waters of the Kistna yields at the most Rs. 8 per acre, while in Tanjore the State often receives twice as much. The people have become by tradition and practice experts in the art of irrigation, though their greediness and selfishness often leads them to apply too great a volume of water. Unless they are watched they will at any time of need turn drainage cuts into irrigation channels by damming them, to the injury of their neighbours and of the system. There is no feeling of obligation on their part to the State or its officers, but, on the contrary, any attempts to improve the alignment of works are met at once by exorbitant demands for compensation. What horse-racing is to the Australian, litigation is to the Hindu; it is his favourite sport, and since he has learned the astonishing fact that judges paid by the Government lean rather in favour of any private person who conceives himself to have suffered because of the execution of a public work, he has indulged his passion to the full. The harvest which irrigation has brought is thus often used to fight the Government which has given the means of irrigation.

Evidences of prosperity according to the native standard are everywhere at hand along the course of these canals, which not only water many fields, but help to maintain the supply in multitudinous wells at a high level. The villages are often as mean as those of Egypt, though as a rule the buildings are more spacious and more convenient than those of the fellahin; but the fields are rich, and bear luxuriant crops, forty-four forty-fifths of which are paddy. The people are well fed, and so for the most part are their cattle. Their contrivances for distributing the water are of the crudest. and nothing more than temporary expedients are sought to secure its diversion from a village ditch or allow of its spread in the field. Experts they may be, but they are certainly not workmanlike; they are prosperous, but they make no permanent improvements; their con-

dition remains to-day what it was when exposed to all the sudden levies and unjustifiable confiscations of the old despotism. With such opportunities neglected, it is more than ever manifest that material progress in Asia does not proceed upon the same lines as in Europe. The numbers seem to forbid individual aspiration. It is hard to conceive circumstances more favourable to a stable development than those of Tanjore, and yet, except perhaps that they are better fed, its inhabitants are not in advance of their less favoured comrades north and south.

The scenes presented on our return from the inspection are those beheld everywhere in these regions. In the dying daylight we pass scores of labourers strolling homeward from the fields, and many empty vehicles of those who have carried their produce to the town. The air is still, and a great flush of glowing crimson mounts from the western horizon to the zenith, embracing more than a third of the sky. A trotting bullock, with brass-tipped horns and amulet necklace of coloured glass, swings his dewlap, and jangles his bells, as he rattles lightly along with his little gig and dusky driver. Children are gathered at the doors of ryots' huts by the wayside, and here and there a little sparkle of light discovers the fire where rice is cooking. Two or three aged revellers from an arrack hut babble aimlessly together, squatting in the dust, but, except the busy squirrels, who people every tree, or a belated bird seeking its nest, all is motionless. Suddenly a figure appears in the gloaming, with uplifted hand and warning cry, to which the only reply of our driver is a lash of the whip upon his jaded pony, which he fiercely urges to the comparatively headlong speed of five miles an hour. Another cry from the sentinel, and a swarm of companions, young and old, emerge from a roadside hut, and fling themselves wildly in pursuit. Before we have gone 50 yards we are surrounded, our horse's head is seized, and the confusion of tongues at the Tower of Babel becomes a terrible reality in the lonely road. To sit silent and suffering in the midst of a torrent of uncomprehended native objurgation is not to be expected of a white, but it is not until our guide is threatened with sudden ejectment from the vehicle that he cools sufficiently to explain that, it being after nightfall, another toll of one penny is demanded from us. Rather than diminish his own and the driver's gains by that sum he was prepared to argue the point till next morning, or die in defence of his purse. The production of the coin reduces the whole of the clamouring crowd to whispering content and many obsequious salaams, with which they fade into the shadows again. We take our way placidly along a grey road, the canal water at its side beginning to gleam softly here and there with reflections of earliest stars, while the evening air, still warm, is panting lightly, as if for a fuller breath of coolness. The deepening darkness reveals fire-flies pursuing their brilliant zig-zag flight against a dark background of trees, until the bridge is crossed, where the wide slow stream is lapped almost noiselessly by the lip of the island. Then the glimmer of the bazaars breaks upon the blackness as we plunge into dimly-

lighted ways, and thread narrow lanes and chattering throngs, to the further side of the town. Looking back as we leave it we behold the huge rock of Trichinopoli against the large serenity of the cloudless heavens, enormous, gloomy, threatening, obstructive, like the creed that crowns it proudly with a glittering triangle of great lamps, which shine far across the night, and burn through all its watches in honour of the shrine of Siva.

CHAPTER XIV.

EKRUK AND KHADAKVASLA.

The chief waterworks in Bombay proper are all either storages, or are associated with storages. These are of two classes, accordingly as earth or masonry dams are employed, an instance of the first being offered in the Ekruk tank, near Sholapur, and of the other in the Khadakvasla weir, near Poona. Compared with those of Madras, the Bombay schemes are smaller, more inland, and have called for single works of greater magnitude. The people are less practised in the use of water, and the crops grown by its means less productive and less profitable.

The city of Sholapur, at which we make a halt, though possessing no monuments of remarkable note, is not without interesting features. It displays the typical aspects of inland towns and exhibits that blending of Muhammadan with Hindu influence which, strange in the south, is manifest everywhere to the northward. The well-built houses and shops, two or three stories in height, are more substantial and stylish than those of Madras, and are often constructed of stone. Trousered women and liberally-robed men are scattered along the street, squatted in recesses or grouped at a turning. They find the morning air at this time of the year keen, and gather eagerly about small braziers. The Hookah slowly circulates among a sententious group, whose keen eyes scan and sum up the stranger. No white man or trace of white man appears. Outside the city stands the fort, with its earthwork walls, flanking semi-circular bastions and lofty towers, the emblem and guarantee of State authority in the Orient. Parts of its gates are built of stones taken from Hindu temples, a combination of utility and insult to which the fiery Islamites are everywhere prone. Close to it a little lake encircles a mosque. A religious festival, probably of the Vaishnaivas, is at hand, and a street of booths has been erected, so that pilgrims may enjoy a fair and fête in the long intervals between their brief devotions. As we pass, a stray and imperfect procession comes wandering through it, consisting of one or two players upon shrill instruments, one or two priests or ascetics, distinguished by caste marks or a liberal scattering of white earth on forehead and breast. A few women and children follow in listless, patient, almost aimless fashion. The passers-by exhibit but the most languid concern in the character or object of the march. It

is an everyday business transaction between the group and one of the deities, which is not reckoned of the slightest moment to lookers-on. The grave father, who sits by the public water tap, with bare body and extended head, while his tottering little child delightedly empties the brass vessel of water upon his head, are both oblivious of the fact that the worshippers are almost upon them.

Strangely in contrast with the scene there rise to the south-west the tall chimneys of a fine cotton-mill, which is owned and worked by natives. This is the only European feature of the capital of a collectorate lying on one of the main railway lines. The rare and casual visitor finds his accommodation in a dâk bungalow, one of those plain, lofty, plastered cottages, furnished with table, chairs, and bedstead-sofas, which the Government distributes over the country in order that its officers may find somewhere to lay their heads when visiting important settlements. The Khansamah, or resident caretaker, provides simple meals at a certain fixed tariff. The traveller in India everywhere carries his own bedding, even when he goes to a friend's house, and his own body servant even when he stays at an hotel. Much baggage and many retainers accompany the Anglo-Indian, especially if an official. To natives his dignity, like that of the Highland chieftain of the last century, is most advertised by the length of his " tail." In this and a hundred other ways it becomes imperative for the European to adapt his life and practices, not to his own wishes, but to the customs and prejudices of those over whom he rules.

The Ekruk reservoir is reached by a country road, excellent so far as a bluestone pumping station from which the town obtains its supply. The water runs from the canal into a bluestone tank 146 feet square at the base, and containing 1,400,000 gallons. The pumps employed are Cameron's patent, built by Tangye, double action, and without crank wheels or brasses. The capital cost of building, engines, and reticulation was under £2,200. A native engineer in charge when questioned is confident that the purity of the water is preserved, because there are stringent regulations to that effect, and patrols appointed all along the channel. On his attention being called to the fact that several native women are washing themselves and their clothing within cooee of the place where he stands while making this statement, and immediately above the off-take for the town, his equanimity is in no wise disturbed. He merely despatches a peon (attendant) to order them to desist, with the certain knowledge that they will probably at once resume operations a little farther off, and next day return cheerily to the familiar place. In such matters Hindu custom is almost unconquerable. Beyond the engine-house the made road ceases, and a bush track begins by dipping to a brook through which our tongas have to pass. The distance to be covered there and back approaching six miles, it has been necessary, in view of the low stature and leanness of the ponies drawing them, to charter one vehicle for each of us. In this district the tongas may be best described as small models of the old Melbourne two-wheeled cabs, in which passengers sat back

to back. There is a broader stream beyond, wherein the pony in my tonga, picking with great caution its deepest spot, proceeds to halt so soon as it is found, apparently with a view to hear argument on the question of his proceeding farther for that day. The example of his fellow decides in my favour, and we mount the opposite bank while the group of native men and women, knee-deep in the water washing clothes, scarcely notice an incident which might have had a ludicrous termination. Washing is reduced in India to its first principles—and so is the article washed. The Hindu process of cleansing consists of lashing the wet garment against a slab, rubbing it on a rock or pounding it between two stones as caprice or material may dictate. It is a fairly effective method as regards the removal of dirt, but it rapidly removes the surface of the cloth also. One surmises that there may have been economic motives at the root of the extraordinary caste prohibition against the washing of garments which exists in a corner of Madras.

The Ekruk reservoir presents a fine appearance, its 4,640 acres of water surface stretching away to a range of low hills, penetrating their valleys and indentations. It was originally intended to have constructed it of mixed masonry and earthwork, as Mr. Stuart Murray has cleverly united those materials in the Laanecoorie weir, though in this instance the plan was to make the flanks instead of the centre stonework. Discovery of the great depth to which it would have been necessary to go to obtain foundations, led to the abandonment of this first conception, and the substitution of a dam entirely of earth 7,000 feet long, with a maximum height of 76 feet. It retains 3,300,000,000 of cubic feet of available water (derived from a catchment of 159 square miles), which it distributes by means of three canals 48 miles in total length, designed to carry 31, 70, and 77 cubic feet per second respectively. Together they distributed 723,000,000 cubic feet during 1888-89, although the perennial canal only took 30, instead of 70 cubic feet per second. This water commanded 15,000 acres, but as a matter of fact only 2,500 acres were irrigated that season.

The smallness of this total was occasioned in some degree by the defectiveness of the scheme, in which the provision for cross drainage is insufficient, while the channels being in black soil call for constant clearances of silt and weeds. The loss in the reservoir itself from absorption and evaporation amounted in the year to more than 25 per cent. of the 4,207,000,000 cubic feet available. Its revenues are recruited from the town supply and from plantations, so as to reach £1,850 a year, while working expenses are £1,323. As the capital cost was £133,000, the net return goes but a very little way towards the payment of interest. Groundnut, rice, grain, wheat, jowar, and sugar-cane are the chief crops, the value of which is set down at £11,600. The rainfall of 31 inches was a cause of some decline in the area of cultivation in 1889-90, being 9 inches more than in the preceding twelve months. The rates ought rather to foster the use of water, since under this reservoir the charge for a perennial supply is 20s. per acre, only one-half of

the rate on the Krishna Canal, and almost the lowest in Bombay, where 16s. is the accepted minimum. The black soil is doubtless largely responsible for the backwardness of the ryots, who find it possible to rely in most seasons, and for most of their crops, upon the ordinary rainfall. The familiar answer is given to those who question the value of this scheme that had it not have been in operation the important town of Sholapur would have been absolutely starved out and deserted during the last famine.

The nature of the work and its magnitude are both apparent to the observer on the dam, whose mass, rising to a crest 12 feet wide, curves across the great valley, its two outlet towers showing a depth of from 42 to 38 feet of stored water at the time of visit. Below the dam the valley spreads away flat for almost the same width, rising gradually at each side to the higher ground, which has a gentle fall away from the reservoir. Some soakage discovers itself in trenches a little distance down, where the old natural channel remains to carry off the drainage and overflow. Farms have been taken up immediately under the right side of the dam, and through the clear air come the voices of strolling goatherds and a couple of cattle drivers who are dividing a small herd. Beyond them a patient ploughman, the constant figure in every Indian agricultural landscape, steadily pursues his task with but an occasional cry to stimulate his beasts. From the millet ripening above the dam to the left arises the constant call of the children, armed with slings, and placed on little platforms above the crop to drive away the birds. The most curious feature of the work is to be found just below the field to the left, marked off by a low masonry wall, in the escape, 300 feet wide, whose dimensions are quite justified, since the flood of 1872 rose within 7 feet of the top of the dam. The two canals run straight across the line of this escape, and being taken at right angles by the full tide of its flood waters, must therefore, one would suppose, be instantly destroyed. But like the escape itself they are cut out of the solid rock, and consequently nothing more can happen to them than that they should be occasionally filled with boulders. These are removed with comparative ease and cheapness, while to cover the canals would be far too expensive.

A second large reservoir in Bombay of a different type is to be found at Khadakvasla, ten miles from Poona, the old capital of the Peishwa, and the present official summer residence of the Presidency, chosen chiefly because, lying among the hills, its heat is less exhausting than that of the seaside. There is a likeness between its appearance and that of Madras, although their situations are so entirely different. The public buildings and places of business are scattered over a large space, and half hidden from each other by trees and shrubbery. The native city is important, and thronged with shrines, though not especially remarkable for either style or cleanliness. As the stronghold of the great guerilla chiefs of the Marathas, it has historic interests, and at least two battles of importance have occurred in the immediate vicinity. In one Holkar

utterly overthrew his rival Sindhia and the Peishwa, or religious ruler of the Marathas; in the other, the British, with a force of 2,800 men, of whom only 800 were Europeans, defeated the Hindu army of 8,000 foot, 18,000 horse, and 14 guns. The temple of Parvati, so much praised and revered, is in this neighbourhood. Its situation, upon the crest of a rocky eminence, is undoubtedly fine, but as a temple it is poor, and in no way worthy of many of the eulogies passed upon it, unless indeed the unusual meanness, dirtiness, and insignificance of modern Hindu places of worship be held to throw into relief every building not absolutely repulsive. Two performers upon stringed instruments, reminding one a little of the orchestra of a Chinese theatre, strum before the chief idol, with eyes attentively fixed upon visitors in the hope of backsheesh, and indeed the whole set of little shrines gathered together in this spot appear to be devised and maintained, like many other holy places, merely to extract coin from the tourist beset at every turn by eager robbers with importunate pleas. This particular spot is undoubtedly held in great veneration by Hindus, and that is its one title to attention. There is nothing visible to repay the ascent, except the view.

The circumstances which led to the commencement of storage works on the Mutha River were of the customary Indian character. Situated just inside the Western Ghauts is a strip of country, upon which from 20 to 30 inches of rain falls in good years at uncertain seasons, and often fails to fall when needed. It was continually threatened by famine, while in the great city of Poona a large proportion of its 130,000 inhabitants depended upon the river for their water supply. When it ceased to flow in summer they were obliged to drink of the stagnant pools remaining in its bed, which received a portion of the town drainage. It was therefore resolved that some plan must be adopted to meet both sets of circumstances by providing water for irrigation and for drinking. A report was furnished in 1863-64 in which a suggestion for the construction of small reservoirs was combatted; a town supply project was formulated in 1864, and a larger scheme for irrigation in 1865 by Colonel Fife. Khadakvasla was selected as the site, and it was advised that a masonry weir should be built 88 feet high, and sufficiently strong to bear another 34 feet when necessary. The Government of India, not considering the plan complete, required further particulars. In 1866, accordingly, the estimates for a weir 123 feet high were submitted by Lieutenant Buckle. Colonel Fife presented an alternative plan for a dam 84 feet high. This was sanctioned by the Government of India, with a recommendation from General Strachey for a larger storage. It was agreed by the Bombay officers in 1869 that an extra 15 feet should be added, but the Government of India then stipulated that this addition should not be made until there had been some years' experience of the working of the plan. In 1871 a revised estimate was sent from Bombay, asking that instead of diminishing the height of the main dam the waste weir should be left lower for a time. The Govern-

ment of India in 1872 insisted on the reduction of 15 feet. The Secretary of State then raised the question of estimates for construction. In 1873 a curtailment of the canals was discussed by the Presidency Government and the Government of India. In 1875 a complete abstract of probable expenditure was filed, and a warm discussion on the question of revenue was conducted. In 1876 the completion of the dam was authorised, on condition that the waste weir be reduced by 2 feet, and the sanction of the Goverument of India and the Secretary of State was obtained in 1877. The work was actually begun in 1869, and was completed about 1879. A story of this kind, tedious as it may appear, is instructive as another illustration of the actual working of Indian administration. A study of the estimates of revenue and expenditure reveals some remarkable discrepancies with the prophecies of experts into which it is not necessary to enter. They go to prove the difficulties even in India of grasping in advance all the conditions under which great schemes are to be executed, or which they may develop as they proceed.

The dam and weir, as they stand, are certainly most imposing. As at Ekruk they stretch across a deep valley, but in this case the work throughout is of masoury—5,136 feet in length, 107 feet high from its foundatiou, and 99 feet from the river bed at the deepest part. Of this immense structure 3,683 feet is dam and 1,453 feet waste weir, which is 11 feet below the crest of the dam, but capable of being raised by means of movable shutters 3 or 4 feet at need. The escape has 12 arches of 10 feet each, 2 feet lower than the crest of the waste weir, employed for regulating the level. Water is admitted into the canal by means of 18 small arches closable with iron shutters. The whole dam—built of bluestone—is 15 feet wide along most of its crest, sloping down according to what is known as Rankine's formula, which requires a greater mass towards the toe than is now considered essential. A considerable part of the valley below is rocky, and great mills have been erected near the canal outlet to utilise the power of the flow. Solidity is combined with fineness of line in this immense wall, tapering gracefully upwards, and preseuting several faces of irregular length, forming a broken curve up stream as it towers above the the dry valley, and stems back a mighty lake $5\frac{3}{4}$ square miles iu extent, and containing above the sills of the caual sluices 3,476,000,000 cubic feet. The drainage area of 96 miles consists of a bold range of bare brown rocky hills with Australian length of line, above which frown sharper peaks, and the plateau of Singarh, famous in native war for its strength and an heroic storming. During the year 54,000,000,000 cubic feet are poured down from this source, to be saved and held in grip for a time by this superb structure, worthy of comparison with the greatest structures of the ancient Romans.

Two canals, the first 70 miles long, carrying 412 cubic feet per second, with a bottom width of 23 feet, a depth of 8 feet and a fall of 4 inches per mile supplies the lower part of Poona, and in a fall

of 2·81 feet yields enough force to pump a sufficiency to the higher parts of the town. It then passes to the military cantonment, and thence gradually reducing in size fills a main tank and runs out into the rural districts beyond. The second canal is but 18 miles in length, and carries 38 cubic feet per second. The two together command 94,000 acres, of which only 49,000 is cultivable, and of this only 13,000 acres was irrigated in 1889-90. This, too, was an increase of 37 per cent. on the area of the year before. Sales of water gave a revenue of £12,000, and the town supply £8,700, with additions making up a total of £22,000, as against £8,673 working expenses, after remissions and refunds. This means 2·13 per cent. on £625,000, the present capital invested in the works. If the 730,000 gallons a day given to the Poona cantonment were applied to irrigation, full rates charged for all water supplied, and the whole scheme dealt with on a commercial basis, it would probably yield 3 per cent. at once. It is capable of extension without excessive outlay, and ought, in the early future at least, to pay its way. The average discharge on which its present earnings from irrigation are derived, is but 147 cubic feet per second, or but a third of its capacity. The average charge per acre is 18s., while the average cost of the water per acre to the State is 13s., leaving a very good profit on all water employed for this purpose.

The principal product in this district is sugar-cane, of which 3,600 acres, valued at £165,000, were watered in 1889-90. This crop only cost an owner of 6½ acres at Mundhwa £7 for a year's watering, although he was mulcted in penal rates on account of his delay in crushing it. He then refused an offer of £220 for it, as it stood on the ground, expecting to realise more by manufacturing it himself. Making a liberal allowance for his own labour and other expenses, this left him quite £15 an acre profit. Without irrigation this crop could not be grown. The great and spiked millets, grain and wheat are the other chief irrigated crops of the locality, the total value of which is reckoned at £200,000. The duty of water in the dry season ranges from 40 to 72 acres per cubic foot per second, so that there should be room for economy in this connection. The main achievement of the canal, however, is in the general sanitary condition of the city as much as in the security given to its surrounding farms. The people have pure water to drink, they are almost removed from the danger of famine, and some of them reap considerable profits from crops artificially watered.

One test of success is whether the State would consent to see the works destroyed if repaid its total outlay upon them with full interest added. There can be no doubt but that such a proposition, if practicable, would be refused without hesitation. The State is already satisfied with its bargain, and that bargain ought to become better year by year. These two works are fair illustrations of the two classes of storage works in Bombay, and indeed of the works as a whole throughout that Presidency. Daring in design and execution, on a great scale, costly, combining storage with flow by means of lofty dams, commanding relatively small areas, and paying

directly but a fraction of the interest upon the capital expended upon them, they are yet held to be more than justified even by the results that have already been attained under many unfavourable circumstances.

A summary of the results of irrigation in Bombay is not to be derived from any merely arithmetical standpoint. The Government are satisfied with the progress made, and the department are sanguine of yet presenting good balance-sheets. Security has certainly been established over large provinces against the suffering, loss, and death which follow in the train of famine. But the changes flowing from irrigation do not depend only upon such contingencies, nor are they remote and anticipatory only. In the old days of Maratha warfare neither life nor property were safe outside village walls, and consequently the trembling ryots herded together in little fortified places for mutual protection. Thus in all the open country were reproduced the insanitary and unwholesome conditions of petty towns. Human beings and animals were penned up together in small spaces, to the injury of both. There was neither comfort in the homes nor attention on the farms. A condition of this kind once established in India has a very good chance of enduring for centuries and receiving at last an almost religious sanction from immemorial use. The Maratha cultivators clustered in their clumsy earthworks for generations after peace was restored. Nothing could have dissolved the practice but a new series of conditions making it the immediate interest of each farmer to get out upon his own soil. Nothing would have distributed them except irrigation, which has accomplished this beneficent change rapidly and peacefully in many parts. It has washed away walls which battle could not breach; it has scattered the homesteads and released the herds.

A husbandman who irrigates needs to be upon his plot early and late. He must work in it at night-time in some seasons. In point of fact he must live upon it. By these necessities communities have been dispersed over their fields, to enjoy more freedom, more light and fresh air, as well as water. The cattle have enjoyed a wider commonage and richer fodder. A better housed people have been better occupied, better fed, and better clothed, rendered more contented and in other ways more civilised; the whole of their life has been lifted a little by raising its material base. This has been accomplished under the very eyes of all observers in the present generation by means of irrigation in the Maratha country. The slums of great cities and sluggish hamlets even in Australia contain a population for whom irrigation can open a similar prospect. It offers health, if not wealth, or probably both health and wealth, in a greater degree than they now enjoy, won, too, by interesting and varied labour upon their own soil, with rest under their own roof-tree, with light tasks, in which their children can join: a domestic and social life elevated and purified by association and co-operation with nature.

CHAPTER XV.

POWAI, VEHAR AND TANSA.

The town supplies of India do not as a rule possess any remarkable features, and indeed considering the size of the country they are both few and poor, when measured by an European standard. The one great exception is to be found in its great western port, and merits a brief description.

Water supply to the island of Bombay has always involved questions of difficulty, and it is now many years since Major Tulloch published a volume containing a complete study of the possibilities of the surrounding country. This has furnished a basis for later developments, though, owing to the extraordinary rapidity with which the port has increased its trade and population, the authorities have never been able to keep pace with the demands made upon them. In this respect there is a curious likeness to the circumstances of Melbourne, where after some years of expedients a bold effort was made to cope with the requirements of present and future by means of the Maroondah scheme. The parallel in Bombay has been the authorisation of the great Tansa project, now upon the point of completion, though it has been necessary in the meantime to add other works to make provision for an interim supply. Taken as a whole, the system as now organised and managed will compare favourably with that of any city of equal size in the empire. The municipality is especially fortunate in its engineer, Mr. S. Tomlinson, the Davidson of Bombay. This gentleman, in addition to high professional qualifications, possesses a personal knowledge of all the large town supplies of the world, including those of Australia, derived from personal inspection. The hospitality he received at the hands of our own engineer in Melbourne and of Mr. Trevor Jones in Sydney obtained for us information and assistance of the greatest value, together with personal sacrifices of Mr. Tomlinson's time, for which there is no adequate recognition.

Salsette, the large island stretching northward from Bombay, is hilly, sparsely inhabited, and enjoys a rainfall of about 100 inches a year. Far up in one of its green valleys, 456 feet above the city, is the Tulsi reservoir, 331 acres in extent, containing 2,305,000,000 gallons, retained by a bank 56 feet high, and caught over 1,700 acres of gathering ground. There is often an overflow from this lake into the Vehar watershed of 2,500 acres, upon which a rainfall sometimes as low as 40 inches, and in wet years rising to 120

inches, but averaging from 80 to 100 inches, is secured by means of an embankment 60 feet high, of earth pitched with stone, which stores 11,425,000,000 gallons, 268 feet above the town hall datum. When it became plain that in spite of these there was a strong probability of the supply to the city failing before the Tansa water could be brought in, Mr. Tomlinson designed and executed with marvellous quickness a third supplementary supply at Powai, where the overflow from Lake Vehar in its turn and the rainfall over 1,950 acres is collected by a masonry weir 50 feet high from its foundations, and 25 feet above bed level, impounding 580,000,000 gallons in an area of 450 acres. The top water level is 190 feet above the city, and this being the same as that of the distributing reservoirs in proximity to Bombay it is necessary to pump from this source 100 feet higher. The water from the chain of three reservoirs is assisted by two distributing tanks, one at Malabar Hill, the other at Bhandawarda. The area of the island is 22·25 square miles, of which 17·55, containing 600,000 people, draw directly from Vehar, 4·7 square miles and 170,000 people from Tulsi, the first giving 11,000,000 gallons, the second 4,750,000 gallons, or a total of 15,750,000 gallons daily. Powai adds 4,000,000 gallons, so that the maximum supply at Bombay to date is much below that of Melbourne or Sydney, though they have less than half its inhabitants.

The Powai reservoir may be fairly considered a monument to Mr. Tomlinson's capacity and enterprise. On 28th October he returned from a long furlough; on 13th November he proposed his scheme, which passed the committee on the 20th, and the corporation on the 25th. On 24th December he obtained possession of the land: and on 8th July the work was finished, the engines were started, and the water was pouring into Bombay. The weir is a pretty little piece of masonry 638 feet long, with a vertical face up stream, and on the down stream side a batter of 6 inches to the foot, diminishing to 4 inches per foot. The crest has a slope of 1 foot upwards from the front, finishing in a knife edge at the rear. The common practice of putting the edge in front and giving the crest a slope to the rear simply accelerates the force of the overflow. The reverse shape adopted by Mr. Tomlinson minimises it. After the foundations were in 18 feet, the remaining 40 feet were built at the rate of a foot a day. Yet it bears no signs of hasty construction, is of solid ashlar set in cement, and fulfils its purpose perfectly. The pumping plant consists of two Worthington's triple expansion pumping engines with Babcock's boilers, each capable of lifting 4,000,000 gallons a day 100 feet high. The quantity pumped is not one-fourth of, but the lift is three times as great as, that of the Victorian made engines in use on the Goulburn before the completion of the new channel. The Powai weir is capable of bearing another 5 feet of crest. Its cost was estimated at £10,000, the engines at £9,000, their erection, housing, &c., £7,250, and the new mains at £10,000. The total, with contingencies, amounted to £45,000, and the scheme was actually completed for this sum in

spite of the employment of day labour and the pressure of urgency. If it had been possible Mr. Tomlinson would have preferred if wrought steel pipes, after the pattern of those which have saved the Victorian and New South Wales Governments some hundreds of thousands of pounds, had been substituted for cast iron. Even when Tansa is giving its full quota this little scheme will be capable of being utilised for a gravitation supply to low levels in the town, while the engines may either be sold or preserved for emergencies.

The water obtained in Salsette is pure, save that the intense heat of the sun favours a rapid growth of protococci, which should be checked by lime or filtering. The same remark might once have applied to the Melbourne system, where there is still a sufficient need for the gradual introduction of what is known as Deacon's meter system for the prevention of waste. When Mr. Tomlinson established it in Bombay, he discovered that the losses in parts of the reticulation amounted to from 60 per cent. to 70 per cent. of the stream entering the pipes. The meters indicated upon their dials that there was a steady run between 11 p.m. and 4 a.m., though between those hours the taps are very rarely drawn upon. This flow was traced until its exact locality was discovered, and the continuance of the wholesale waste stopped. Although the system has only been in operation for a few years, losses amounting to 3,000,000 gallons a day, or one-fifth of the total supply, have been detected and checked. There has been a drain from the works themselves, repairs having been required to the Vehar Reservoir because of the faulty construction of its waste weir, through which 1,250,000 gallons was finding its way. Then the Bhandawarda Reservoir leaked to such an extent that 7 per cent. of the daily intake disappeared, and £24,000 had to be spent to put in order a £90,000 work within four years of its execution. The engineers in this instance maintained a constant struggle with the contractors as to the quality of the work done, but did not push their activity far enough to prevent inferior unburnt bricks, insufficiently ground mortar, and salt or unwashed sand being employed, while the puddle was put in without proper backing. Sir John Fowler recommended asphalt flooring for these reservoirs, but practical trials have proved the superiority of concrete. The history of every Indian water supply teaches that good inspection is as important as good design, and that eternal vigilance is the price of efficiency.

If beauty of situation were a factor in water supply Bombay would have every reason to congratulate itself upon already possessing two artificial lakes whose charms may well be said to rival nature's most exquisite handiwork. Tulsi and Vehar lie among hills, most of them of no great height, but all of them garlanded with a profuse vegetation, the offspring of an ardent sun, frequent moisture, and a propitious soil. The dam at Vehar adds rather than detracts from the scene with which it blends, as if itself a work of nature; the boldness of its semicircular sweep looms above a tree-filled valley with the semblance of a natural platform; out

of the thickets of dark green shrubbery which clothe its slopes down to the water's edge rise with stately grace superb clusters of the proud Palmyra palm. Slope blends with slope, beyond and around the reservoir, until in the distance there stand like sentinels great peaks whose gaze is skyward. Its pellucid water rippling away to broken shores, opening and closing like the bays of Sydney Harbour, tells no tale of the eight-feet alligators and water snakes which lie hidden beneath a silvery surface. An Italian lake, some evening when the higher Alps are hidden in haze, and when the evening light falls with faint tinges of colour along its cliffs and climbing gardens, appears to have arisen in the heart of Salsette. Far down the valley lies the dim line of the open sea, where the last rays glint on the long low line of buildings in Bombay. The flush dies, daylight fades, stars spring out, the slow plashing of oars in the water lulls us as the boat, propelled by its picturesque native rowers, floats out upon the bosom of Vehar, whose beauties are swiftly shrouded in a vestal veil of mist. "A lake is the eye of the landscape," and assuredly there is fascination in this orb, exquisitely fringed and full of sweet expression, as it looks peacefully up to the clear still Orient sky.

Very different is the spectacle presented next day at Tansa. Two or three hours on the railway has been followed by a long drive through the hills in a tonga drawn by a couple of sturdy ponies. The pole has a cross bar resting upon the necks of the horses, while it passes through the body of the vehicle to the axle of the low, easy running little trap. Numerous teams bearing material for the work, and provisions for the workmen, are crawling up the road, or halting dreamily beside it for a spell. Coming sharply round a mountain curve we behold before us a wide valley, expansive rather than beautiful, bordered by low hills, and beyond them by many ranges of the Western Ghauts. Right across this runs a shapeless ridge over which some thousands of Hindus, three parts nude, are swarming like so many ants. The clink of the masons' hammer and chisel is heard beside us as they squat in knots before the stones they are cutting to shape; the drivers of teams of small cattle are urging them up the incline with their loads of spoil. There is a whirr of machinery from the flat below the dam, and whistles from the great stretch of water, and from the pits below as steam launches and a contractor's railway rattle to and fro. But for the most part the only sound is the rippling tide of chatter from legions of brown skinned men and women, bearing earth away or mortar to the work in flat baskets, emerging from quarries, or returning from the landing place, carrying blocks of stone upon their heads. Somewhat in this fashion surely were the pyramids built; by such long lines and endless chains of human beings were the Teocallis of Mexico reared to their height; with flesh and blood of workers such as these have mosques and temples arisen in India, and, indeed, all the world over, to the honour of God, at the behest of one man, by the sacrifice of thousands who were subject to his will.

This work, utilitarian though it be in its ends, and without sacrifices to idols or tyrants, is not without its hecatomb of victims. Every European on the work has been prostrated with fever. Half the staff were absent at the time of my visit. Some of their predecessors have left their bones beneath the turf. Of the number of natives who have died there is no record. When cholera appeared in a neighbouring village of 137 souls all told, 97 answered to its summons. The ordinary mortality of the host of workers must reach considerable figures. The living army is still numerically strong. Scattered villages and an extensive bazaar have been created for its needs, and, as I see them, are thronged with crowds of purchasers and sellers. Eight thousand people are present at this time. There have been 12,000. The week before my arrival 6,700 had received pay for labour upon the dam itself, besides the miscellaneous crew of camp followers who live upon them and minister to their wants. These workpeople come from long distances and remain for the dry season, returning to their farms when the wet weather begins. Unskilled men in Bombay receive an average of 5d. to 6d. per day, women half as much, carpenters 8d. to 10d., masons 10d. to 1s., smiths 1s., engine-drivers 1s. 6d. to 2s., clerks £2 a month, and their responsible chief, £100 to £150 a year. The wages at Tansa are rather less, and would have been distinctly less but for the competition of neighbouring contractors who are building the duct leading from the dam to the city. On this there are employed some thousands more. Nor is there any sign of the grinding poverty which such wages must suggest to the Australian. The labourers appear well fed, contented, and cheery, have all the clothes they desire, all the food and lodging they are accustomed to, and all the leisure they have learned to expect or use. It seems almost impossible to individualise them, so many are they, and so alike. The inevitable suggestion of their appearance is not of human but of animal life. The sunlight falls upon them as they ascend the work by wooden stages or troop along its crest, or are massed in some common task of strength at one part of it, just as it would fall upon bees or beavers. Under guidance they perform their tasks as if with similar instincts, and with a similar communal understanding, to the insect or animal builders whose patience they emulate and whose arts they rival. Hence, from the veteran Anglo-Indian, there might sometimes be heard an unexpected answer if the question put in the mouth of a darker race, "Am I not a man and a brother?" were asked by the Hindu.

The great dam of Tansa is now 116 feet high, and contains 1,423,000,000 gallons, being built so as to carry 15 feet more crest when necessary. The dam consists of a Titanic wall nearly 2 miles in length, 117 feet high from its foundation at the deepest part, with a breadth at its base of 101 feet and a crest thickness of 15 feet. It contains 11,000,000 cubic feet of masonry, and is thought to be the largest weir of the kind in the world. Its erection has already occupied three years, being carried on by means of 6 miles of tramway, 2 steam launches, 16 boats, 150

trucks, 4 pumping engines, 4 portable engines, and 7½ miles of piping—not a remarkable list of machinery for a structure of this size, unless it is remembered that in India it pays better to do everything by hand.

Messrs. Glover and Co., the contractors, have a more than Indian reputation for the magnitude of their enterprises and the quality of their work. Mr. Bedford, who has supreme control of the undertaking, is their most experienced and most competent representative. The administrative duties in connection with such an army of employés in such a country might discourage all but the ablest men. The contract for the dam is £330,000, while the duct of 53½ miles by which it is to be conveyed to Bombay is to cost £480,000. Even at that price the contractors for the latter work were unable to proceed, and an extra allowance of £9,000 has been accordingly conceded to them by the corporation. With the mains that must be laid the total cost of the supply of 17,000,000 gallons per day, with tunnels capable of carrying 33,000,000 gallons in twenty-four hours, will be £1,260,000, according to the estimate, and probably nearer £1,500,000. One portion of the weir for 1,650 feet is 3 feet lower than the rest, serves for a flood escape, and should furnish a splendid spectacle, when the monsoon torrents are rushing over it with a fall of nearly 100 feet sheer upon the rock below. But for the discovery of a curious flaw in the stratum upon which the weir is built, where a mass of earth, partly volcanic ash, penetrated it transversely to a depth of 10 feet, the whole structure might have been burst by the first great pressure put upon it. It has stood the weight of 90 feet of water and of a heavy overflow already. Its connection with Bombay will place that great city in an independent position as regards water supply for many years, and will add another to the long list of colossal hydraulic works in India.

A comparison between the cost of town supplies can very rarely be profitable, since the natural features of each place are the chief determining elements in every case. Yet there are some curious likenesses between the Bombay and Melbourne schemes, which are worth mentioning. The Vehar-Tulsi-Powai branch is, like the Yan Yean, Wallaby Creek, and Silver Creek, a chain of supplies, one falling into the other; and what the Maroondah extension is to it Tansa is to that of Bombay. The rough, hilly country near the Nimmo Falls is not at all unlike the Ghaut jungle, while there are scenes in the valley of the Watts whose loveliness may be contrasted even with the glimpses seaward from the summits of Salsette. In each case the chief outlay on the great addition has been the lengthy channel of conveyance by which the new source has been linked to the old, but we have nothing to compare with the Tansa dam, which probably contains more masonry than all the stonework in the dams and weirs of Australasia put together, while its whole cost, with that of its channel, is little more than that of the new Maroondah supply. Both schemes have provided for future extension. Melbourne receives at present a maximum supply of 46,000,000 gallons a day, or 92 gallons per head of the population.

representing a capital expenditure of £3,500,000. The Bombay water supply as now on the point of coming into operation will cost about £2,500,000, giving by gravitation from 32,000,000 to 35,000,000 gallons per day, or a certain 32 gallons per head. This is a reasonable supply for Europeans, but it is magnificently lavish for natives, so that it will not be likely to need extension for some years to come. The public spirit which has supported such an investment in an Asiatic metropolis, the engineering talent exhibited under exceptional difficulties, the magnitude of the means employed to surmount them, and the impressive vastness of the works themselves, approach the American scale upon which immense supplies are given to the great centres of the United States, and confer of themselves another title to fame upon the opulent city of Bombay.

CHAPTER XVI.

THE GANGES CANAL SYSTEM.

There is nothing in the irrigation works of the Central Provinces, nor yet of the native States calling for special description, and though one or two of the schemes in Bengal are of considerable size, they possess few novel features. The North-west Provinces, on the other hand, have been the chief theatre of canal and well irrigation. The twofold system drawing its supply from the Ganges is perhaps the greatest and most famous in the world, and though in itself entirely modern, is connected by association with a far-off lengendary past, the beginnings of national life, its marvellous epic poetry, the most sacred river, and most illustrous shrines of Hindu faith, and the dawn of the independent history of India. We touch here the very heart of ancient India, and the origin of many of the current beliefs of its hereditary irrigators.

To primitive man—worshipper of the elements—water was almost as much an object of reverent wonder as fire. In his pastoral stage the rainfall was desired for the grass, and when he turned agriculturist the growth of his crop sent his thoughts daily to the skies. One of the earliest of the Vedic poems illustrates this natural prayer for rain among the early Aryans in North-western Hindustan—"The winds blow, the lightnings fly, plants spring up, the sky pours. Food is produced for the whole world." Then comes the practical invocation to the deities of the storm—"Draw up the large bucket and pour it out; let the streams pour forth freely! Soak heaven and earth with fatness! and let there be a good draught for the cows." Rig-Veda. v. 83. To this day, according to Monier Williams, all running water in India is held to be instinct with divinity, while Keary interprets the serpent worship, universal among savage peoples, as symbolic of the rivers. Some Vedas speak of the waters as goddesses, and style them "mothers of the earth." The Greek poets beheld Aphrodite rising from the ocean, and sang the sacred springs of Castaly. St. Francis of Assisi has glorified water in one of his most exquisite hymns, and holy wells are still to be found in the country districts of the old world.

That rivers should have been worshipped need not surprise those moderns who have felt their mystery, or realised their utility. Their birth, when spring or snow fed, was incomprehensible to early man, who recognised the beneficence that quenched his thirst

cleansed him and his garments, furnished finny food for his camp, and a highway for his trade. Before railways and roads were, the current of the streams carried to him the merchandise of distant climes, and opened strange scenes upon the traveller's view. The sublimity and terror of flood appealed to the fear which begot a trembling anxiety for propitiation; the gentler inundation with its rich gifts of herbage awoke sentiments of pious gratitude. Thus the thoughts of men were floated by the river into far-off regions and strange imaginings, and to their vision it became imbued with a life and being of its own. Many rivers, if not all, are sacred in India, and one at least is regarded as baneful in its influence. The Ganges is held holy from its source to its mouth; great cities have grown by its side, the most magnificent edifices of which have been reared in its honour; it has its throngs of priests and hosts of devotees, and its water is carried in phials for hundreds of miles to moisten the lips of the sick or dying. To behold it is virtuous, and to bathe in it is to become morally clean. Its banks are sanctified, so that among the most meritorious of acts is the foot pilgrimage, or Parikrama, from Gangotri to Gangasagara, down one side of the river and up the other to the starting-point, a journey which occupies no less than six years. The Brahmans of the Narbada insist that the sanctity of the Ganges will perish four or five years hence, but there is no likelihood of such a disaster while so many rival priests derive a living by ministration to the visitors who pour daily into Hurdwar, Banaras, Allahabad, or other of its shrines.

The Ganges has had special claims upon the Hindus for thousands of years, during which its stream has flowed in their service, broad and strong from its very entrance into the plains. Beyond the Sewalik hills and the Deyra valley it may be traced into almost inaccessible gorges of the Himalayas, whence it draws its perennial supply of mountain waters by several arms. What is taken to be the source of the river is a snow bed 13,800 feet above the sea, considered by the faithful to be the foot of Vishnu, or the hair of Siva, according to the sect to which they belong. At this point it is 15 inches deep and 27 feet broad. Its career at first is wild in the extreme, as may be judged from the fact that it falls more than 12,000 feet in 180 miles, leaping from hills covered with dense thickets, in which large game is plentiful, and where beasts of prey are not rare. Passing through a gorge in the Sewaliks, with a minimum flow of 7,000 cubic feet per second, it enters upon another country and other duties, traversing an immense alluvial plain, to which it brings fertility, and where it is used as well as worshipped by millions to whom with all its tributaries it brings the means of life. Their thoughts turn with their eyes to the far-off white summits whence it first emerges into the light of day, the grandeur and loveliness of its mountain birthplace lending it an additional charm and mystery, so that garlanded by the imagination of the poetic, robed with awe to the pious, and laden with plenty to the prosaic, the sacred stream is ushered upon its majestic career.

Varied as are the physical conditions of India, there is one characteristic of its rivers which is all but universal throughout the whole of its vast territory. Everywhere there is a great variability in rainfall, and everywhere therefore one beholds marked traces of the two states of the stream, the ordinary flow and the extraordinary flood. Whether on the coast of Madras, the high plateau in Bombay, the arid plains of Rajputana, or the rich alluvial of the North-west Province, one finds the rivers in the dry season shrunk, as a rule, to small streams, taking a sinuous course through a wide sandy or muddy plain, sometimes barred with rock among the hills, bnt having on either side of it the high banks of a valley, which serve to contain the turbid waters of the rainy season, rushing down sometimes miles in width. As far down as Banaras you find one bank of the Ganges high, and on the opposite side a wide plain over which the floods occasionally stream. In this part of its course. and in this respect, it bears a considerable likeness to the Murray, which has rarely cliffs on both banks until past the Victorian boundary, and expands at times for indefinite distances on one or both sides of its customary bed. Both rivers have changed and are changing their course continually, though this is much easier in India because of the absence of those dense forests which hold the Murray flats together, line its anabranches, and help to give to its backwaters the stillness of lagoons. The high flood valley bed of Indian rivers is more and more clearly defined as they are ascended, but the dry weather channel moves frequently and freely within the bounds of this valley, whose soft substance, consisting of material deposited by the stream itself, is readily cut and shaped by the current according to its idiosyncrasies. The task of Indian engineers is therefore at the outset to contrive their headworks so as to be certain of always receiving the permanent flow, and their instructions, like that of the old-cookery book, might fitly begin with the warning. "First catch your river."

The Ganges canal is purely a European enterprise, the only native work which preceded it, in that district, being a simple cut about twelve miles in length, fed from a temporary weir near Rampur, of such dimensions as to have made the supply given by its means to the gardens of Meerut extremely expensive. Colonel Colvin is credited with the first conception in 1836 of a scheme for watering the north-eastern part of the Doab in the same manner as the Eastern Jumna canal watered its western side; but it was not until the customary spur of famine was applied in 1837-38 that the Government ordered a thorough examination of the proposal. Sir Proby (then Captain) Cantley submitted the first project in 1840, and it was under his direction that the schemo was developed until it attained its present proportions. Commenced in 1842, and completed in 1854-55, the canal did not come into proper working until after the suppression of the mutiny in 1857, parties of the rebels having evinced their intelligence and patriotism by a vain attempt to destroy portions of the work. The channel was no sooner filled than grave defects in its construction were apparent, and

the final result of several commissions was the authorisation in 1866-67 of a remodelling of the design, which in 1868-69 was again amended so as to assume its present shape. Sir Arthur Cotton, called in to criticise the original plan in 1863, had condemned it almost wholly, and recommended, in its stead, the construction of a new headwork for a new main canal much lower down the river. Ultimately this proposal of his was adopted in addition to, but not in substitution for, the existing plan. Work on the second line was commenced in 1871, but it soon became evident that the estimates of cost were wholly insufficient, and in 1876 it was amended considerably, being finally completed in 1880, though its distributaries were being extended for some years later, and, owing to the destruction of the Kali Nadi aqueduct, important work has been proceeding upon it up to the present time. The two schemes are practically one system, and may be most conveniently dealt with in that relation, although still separated in official publications. There are two headworks, it is true, but they water the same district and blend their supplies for the purpose.

It would be easy nowadays to treat Sir Proby Cautley to patronising comments upon the plans which he prepared, the most expensive of which was to require less than £1,000,000, while the actual work has cost three times as much. Perhaps more deserved censure would be due to the officers who adopted Sir Arthur Cotton's supplementary scheme in 1871, and who, with the previous experience of the older works to guide them, brought in a preliminary estimate of £1,800,000 for a scheme which in 1876, they admitted, was likely to cost at least £3,265,000. Sufficient will have been said upon this point if it be noted that in India, as elsewhere, a good deal of experience has been required before it has been possible to obtain trustworthy estimates. The ablest engineers have proved at fault, and it has only been after many failures that the present accurate forecasts could be furnished. The errors in construction have been proved to be less serious than was supposed in 1863-64, and considering that Sir Proby Cautley was the first to undertake the design and execution of a great river canal, the general soundness of his judgment and wisdom of his project must be conceded.

Everything connected with the Ganges canals is upon a scale of magnificence from the headworks which battle with the river for miles, down to the masonry-lined channels, with drops and bridges of massive construction by which the surplus waters find their way back again through the centre of Cawnpore to the stream from which they came. The description of the works occupies three large volumes and a large atlas plan, in which the great scheme is recorded with minutest detail. Engineers of every civilised country have made it a study, so that its reputation extends all the world over. The latest treatment of some of its aspects is to be found in a series of articles contributed to *Engineering* by Mr. L. R. C. Nicolls, one of the executive officers of the canal, since republished from the office of that paper under the title "Agricultural Engineering in

India." This little volume is one of the few books relating to irrigation which may be read with pleasure as well as profit by the lay public or the professional man, for its style is terse and lucid, its substance interesting, and its treatment fresh and varied. Sketches of phases of official life upon an irrigation canal are most pleasantly and graphically intermixed with valuable studies of practical works and working. As Mr. Nicolls says, the Ganges canals to-day are not the creation of any single mind, but of many minds, for though in the first instance planned according to first principles they have since been greatly altered, and shaped bit by bit to the circumstances of the country. They have been amended from time to time until they represent the net result of the knowledge of irrigation gained in this part of India. It will be well, therefore, discarding technicalities and details as far as possible, to give a general outline of the system, which embodies the ripe experience of the thirty-four years' practical working upon it of some of the ablest irrigation engineers in the world.

To understand the headworks of the old Ganges canal one must appreciate the nature of the river to be controlled. Dropping at times below 5,000 cubic feet per second, a narrow stream, following a winding course through its valley, the Ganges at times pours down from the hills a river of great breadth, 10 feet or 15 feet deep, rushing with the force of a torrent, and rising with such rapidity that it has often been a matter of the greatest difficulty to close the regulator gates against it. A few years ago an officer prepared to blow up the head of an escape, so as to endeavour to save the great aqueducts and falls in the canal from being irrevocably wrecked by a flood then threatening. Although the works are being strengthened year by year, their maintenance is still a matter of much anxiety. Gauges are maintained higher up the river, whence warning of the state of the stream is promptly transmitted. Nevertheless the campaign every year is critical, and fresh designs are now in course of execution for the protection of the supply.

Where the river debouches from the hills its broad stream is broken by an irregular line of five flat, sandy islands, the lowest. Bailwalla, of considerable size, above which and divided from it by a narrow channel is another island of about the same width; above this again are three smaller islands, two of them close to it and each other, directly up stream, while the third, a long spit, projects past them up the river approaching its right bank. Here the works begin, by a permanent weir of boulders in cribwork, the outside layers in mortar, and with an even crest, so as to send the river when low down to the two smaller islands. A temporary dam, also of boulders in wooden cribs, deflects the stream farther to the right, past the two islands and the larger one immediately in their rear, two bands of shingle uniting these, and catching any leakage from the first. The larger island is connected again with Bailwalla by a permanent masonry weir with drop gates opposite the town of Hurdwar, so that by this series of weirs, connecting the islands in a line, the low river is kept close to the right bank all the way, until

at last, at the lower end of Bailwalla, it reaches the canal regulator at Myapur on the right side, while on the left, in line with it, are the main river regulator and escapes. For nearly two miles by means of these works the river is led in a natural channel to the canal, the weirs each permitting floods to pass over them, and the Myapur regulator finally determining the depth at the canal entrance. Exposed parts of the islands are protected by revetments and spill-overs, and by embankments, which with spurs stretch five miles up stream, so that by degrees this complicated series of temporary and permanent works is gradually gaining mastery over the mighty stream. The boldness, watchfulness, ingenuity, and patience, exhibited in this scheme, the outcome of years of strife with the elements, are beyond all praise.

The original Myapur headwork consisted of a brick regulator, with 10 bays of 20 feet each, 16 feet high, two wooden gates in each bay, inside the mouth of the canal. The river was governed by means of a weir 517 feet in length. Its central escape, resting upon a 3-foot floor of brick, over boulder masonry, 44 feet wide. has 15 openings between brick piers, 8 feet high and 10 feet apart, fitted with drop gates and further raised by means of planks. The weir rose from the centre to flank walls on each side 24 feet in height, extending 800 feet down stream ; a lock stands above the canal mouth running from it at an acute angle. For the existing canal entrance it is proposed to substitute a new two-storied regulator with 10-feet openings, placed at right angles to a new dam, but owing to an accident to one of the great aqueducts it has not been deemed advisable to risk the construction. The river dam has been greatly improved by the introduction of five 20-feet escape gates, set in arched brickwork, which were erected in 1882-84, the stream in the meantime being diverted in a curve through Bailwalla Island right round to the rear of the existing structures, a new regulator governing the entrance of the canal, and an escape being made where it crossed the former river bed. The old boulder floor was cut through with hammer and chisel in trenches six feet deep, and then filled with concrete, composed of two parts of stone ballast to one part of Kunkur lime, to form a foundation for the new dam, which is now considered capable of resisting all the strain that can be put upon it. There is some controversy as to the position of the canal regulator, but it is admitted that the present situation is bad, for although it allows of a pool of still water being formed on its face to act as a cushion, yet this ensures a great deposit of silt. which most seriously impairs the capacity of the intake. A good scour is essential, with gates of smaller dimensions to permit of more rapid lifting and closing.

The spurs employed to guide the river and strengthen its banks are usually commenced with boulder-filled cribs, thrown in and washed down until a good foundation is obtained ; the upper parts are set in mortar, silt gathers in the elbow, grass is planted, and a solid mass is the result. The flanks of the islands need to be protected in this way here and there. Work has not yet ceased at

Hurdwar, and though, when the regulator is finished, it is thought that further expenditure will be only for minor river improvements, there is no certainty that even then the engineers will have completed their labours. Certainly they can never desist from their task of controlling the flow, or from the obligation of maintaining their sentinels along its course in order to detect its encroachments. The duty of determining from day to day the quantity necessary to supply the demands of the great area dependent upon the scheme is itself a matter of difficulty and delicacy, upon which the lives and fortunes of thousands may depend in times of crisis. It demands a cool head and nice judgment to decide what policy to adopt for safety, when weirs are breaching, embankments leaking, and the river roaring down in flood.

So far from having conquered the situation when the stream has been kept in its course, the headworks maintained in order, and the requisite supply admitted to the canal, the engineers have then the most serious difficulties to face. In the first instance there is an artificial river to construct, 200 feet wide, and running sometimes 10 feet deep, across hundreds of miles of country at an even fall—no mean undertaking under the most favourable conditions, but rendered inexpressibly difficult in the sub-Himalayan tracts, where valleys, which in fine weather are dry with dust, become foaming torrents of great magnitude and tremendous velocity during the rains. The Ganges Canal, being carried right across the drainage line of the country, has to face four of these in its first twenty miles, besides a number of minor drainages whose waters are taken into the canal itself, which is protected by escapes at short distances, through which excess water can be discharged.

American irrigation engineering is noted for the cheapness of its contrivances, doing wonders with wooden fluming and labour-saving machinery, but no single scheme in the States can be compared with the great Indian undertakings. In Europe the Cavour Canal is the standing example of solid workmanship; its masonry aqueducts, one of which is 635 feet in length, and its syphon at the Sesia 870 feet in length, being pointed to with admiration. There is nothing in Europe, in or out of Italy which can compare with it in finish or scale of construction. But the Cavour is not as large as several of the branches of the Ganges Canal, has less than a third of its dimensions, and receives at its head little more than a third of its supply. With all its contributions from older canals, it only distributes the same quantity of water as the Older Ganges system. The Solani aqueduct has 750 feet in length of clear waterway, upon 15 arches, or 920 feet of masonry in all, bearing a channel 164 feet broad and 10 feet deep, upon foundations 252 feet wide, resting on wells sunk 20 feet below ground. The up and down stream continuations are carried on an immense earthen embankment whose base is 350 feet wide, making 15,700 feet, lined with masonry between banks 30 feet wide and 12 feet high—a far grander work than anything on the Italian canal. The total channelling on the Cavour Canal is under 1,000 miles, while each

of the canals from the Ganges has over 3,000 miles. The same comparison maintains in all other features of these systems. It must not be forgotten that the Italian works were constructed in a temperate climate, in the heart of Europe, in a well settled country, with abundance of skilled labour, and under the eyes of the authorities, while the Indian canals have all been executed under a tropical sun by coloured workpeople; most of them in a thinly peopled country where skilled labour was scarce and poor, and supervision difficult. To realise their merit, the circumstances of the country and people must always be borne in mind. Engineering in Asia may usually need less money, but always implies a greater tax upon the health, patience, and brains, of those responsible for it.

To recapitulate all the important works on these canals would be tedious and perhaps unprofitable, while it would be impossible to describe this gigantic system as a whole without elaborate plans. It is impossible to present even an outline of it without much omission, and much repetition on some points. Its colossal character can be best conceived when a picture is presented to the mind of an artificial river sometimes carried over what in the rains are rivers, sometimes having those rivers carried over it, and at other times taking them into its course. The first twelve miles of the Ganges Canal is in deep cutting, and at the sixth mile it encounters the Rani Rao torrent, transported overhead in a masonry aqueduct termed a super passage, 200 feet wide, and capable of taking a flood 14 feet deep. In the tenth mile comes the Puttri torrent, with a fall of 25 feet to the mile, received on a super passage 296 feet wide, 14 feet deep, and 450 feet long. If the Yarra at Princes Bridge were an artificial canal, if that bridge were three times as wide as it is and, instead of traffic, carried a flood 12 feet deep from the Immigrants' Home into Swanston Street, also three times as wide as it now is, with waves 4 feet high lashing the high walls at its side, one would witness the forces with which Sir Proby Cautley had to cope in constructing this super passage. Strong as it is it was nearly breached in 1885, and money still requires to be spent every year in the construction of training banks in the bed of the torrent, above and below these passages. Long cross spurs, 6 feet high, finished with cribwork on masonry, are run from the sides of the valley above so as to divert the burst of water into the super passage; these have smaller banks between them to encourage the deposit of silt. A breach in some of the larger banks once threatened to let the torrent into the canal, a catastrophe which might have ruined it for miles below. The elaborate nature of what may be termed the fortifications here is such as to convey the highest conception of the daring of those who conceived them.

The Ratmau torrent in the thirteenth mile offers an equally astounding spectacle. It is permitted to flow straight into the canal, a mile of revetment walls on wells sunk 20 feet below the bed, a forest of piles, and an enormous amount of cribwork being employed to protect it. The regulating bridge has 10 openings of 20 feet each, on the same pattern as that at Myapur, so as to pre-

vent an undue supply from rushing down the canal, while the flood admitted over masonry on the one side is given exit on the other through a weir with 47 sluices of 10 feet each at bed level, having on each side five sluices of 10 feet wide at 6 feet above bed level, and masonry platforms beyond them again at a 10-feet level. The first sluices can give a waterway of 470 feet, the second of 570 feet, and the third of 800 feet. Forty workmen are always on guard at this spot to close the canal and open the escape. Being frequently used to get rid of surplus water in the canal, and having a fall of 8 feet to the mile, it has cut back below the weir to such an extent as to call for the introduction of cribwork weirs faced with boulder masonry. The canal itself is revetted on both sides above the regulator, and the torrent is embanked for some distance above the crossing. This has led to drainage collecting between the two sets of banks, which has been led into the canal above. The Solani aqueduct already referred to comes in the nineteenth mile. It is of interest to note that at this point the bed of the canal is for two miles and a quarter above the level of the surrounding country, and according to Buckley at one place as much as 24 feet. In this first twenty miles therefore are works of almost every kind upon the greatest scale—a channel 200 feet wide and 10 feet deep, carried at great depth below the surface, and then high above it, over, and under, and through torrents, which rage with the fury of tropical storms, collected upon the flanks of the hills and hurled downwards, with a violence which, in its Titanic onset, threatens even the most massive masonry.

The main channel, at its fiftieth mile, throws off the Anupshahr branch, which follows closely the line of the Ganges, and then, keeping the main line of watershed between the two rivers for 181 miles, divides into two large branches, one falling into the Jumna beyond Etawah, and the other into the Ganges at Cawnpore. These three branches are now cut at right angles by the Lower Ganges Canal, under which heading these extensions and that of the Bhognipur branch are officially included. This second great source of supply has its offtake at Narora, on the Ganges, where the river is diverted by means of a brick and masonry weir, 3,800 feet long, resting upon a concrete floor 3 feet deep and upon 366 cylinders driven from 20 to 32 feet, its curtains supported by wells, 20 to 22 feet deep. Its crest is $6\frac{1}{2}$ feet above low water, and can raise the water 10 feet higher, by means of shutters; it has on its left side 42 sluices $7\frac{1}{4}$ feet wide, while the offtake has 30 openings of 7 feet. This work was finished in 1878, but only a portion of the canal was excavated, and in 1880, it was administratively erected into a separate scheme. The river at this point has a minimum discharge of 1,085 cubic feet per second, while the maximum capacity of the canal, which, for the first twenty-six miles, has a bed width of 216 feet, and a depth of 10 feet, is 5,100 cubic feet per second. The headwork is entirely different from that at Hurdwar, which represents an intermediate development, combining the temporary weir of the Eastern Jumna with the permanent

weir as at Narora. In these three headworks the Indian system may be considered as summarised. Each is adapted to its special circumstances, and taken together the three indicate a pliability of creative faculty as essential in other countries as it is in India. The contrast between the methods adopted on the Goulburn, the London, and the Wimmera, is an indication that the Victorian engineers, and especially Mr. Stuart Murray, have recognised the necessity of providing for different classes of structure upon differing streams. Two or three types have been tested in India with success, and Australia will need at least as many to meet its manifold conditions of supply.

The strain on the Lower Ganges Canal has come, not upon its headwork but upon the aqueduct, thirty-three miles from its head, by which it crosses the Kali Nadi just after receiving the surplus of the Anupshahr branch of the Upper Ganges Canal. Up to this point it has only thrown off one main channel, that to Fategarh, carrying 625 cubic feet per second, and allowing 300 cubic feet per second for soakages *en route.* This leaves an ordinary supply of 3,175 cubic feet per second, or an extraordinary supply of 4,100 cubic feet per second, if it were necessary to send the whole stream in the canal onward, to be conveyed over the valley in which the river runs, usually about 50 feet wide. In the original plans there was an earthen embankment on each side, between which ran a channel having a bed-width of 192 feet, continued at the same dimensions upon a masonry aqueduct of 5 spans of 35 feet each, giving an effective waterway below of 2,380 square feet. These dimensions were decided upon in 1872-73 after a great deal of deliberation, though with some doubt, because of the absence of many of the data essential to a positive opinion upon the possible discharge of the stream. No actual flood measurements were available, and though the catchment of 3,025 square miles indicated the likelihood of a great volume of drainage, the experience of the previous few years went to show that freshets, said by the villagers to be among the highest known to them, pointed to a discharge of 7,000 cubic feet per second, or at the most 10,000 cubic feet per second. A great deal of stress was laid upon the fact that the flood levels upon a native bridge, a century old, and upon a more recent railway bridge seemed to indicate that a depth of 13 feet was the highest to be anticipated, and that while such estimates as were possessed showed a drainage of only 3·66 cubic feet per second for each square mile of catchment, the waterway was sufficient to pass double this quantity. The work was finished on these dimensions in 1878, and stood for six years, though in 1880 for a short time a flood of 16 feet occurred. It might have been inferred that it had stood the test of time, and approved the judgment of those who designed it. The rivers of India and Australia, however, require a considerably larger cycle before their capacity can be finally determined.

In 1884 a flood of 22 feet came down, when the discharge amounted to from 40,000 to 45,000 cubic feet per second, instead of the 17,850 cubic feet per second provided for, and being headed up

$3\frac{1}{2}$ feet by the aqueduct, tore away one-fourth of it. The fact that the earlier bridge levels could not be relied upon was demonstrated by the carrying away of their approaches, so that a great portion of the stream went round them at both ends. It was evident that the old work, if repaired, could not be relied upon. An estimate for a new work to cost £173,000 was prepared; while in the meantime the injured one-fourth was temporarily replaced, and in two months water was running over it again. Fortunately, nothing permanent had been done, when in July, 1885, the river rose again, this time running a mile wide, and carrying nearly 140,000 cubic feet per second. The aqueduct headed it up 13 feet high instead of $3\frac{1}{2}$ feet; and under this pressure the whole structure was rent. Cracks appeared in the right revetment wall of the channel, the arch rings began to separate from the backing, then the left revetment wall and roadway subsided, waves from 10 feet to 15 feet high rushed over the right revetment, which speedily collapsed; two arches then blew up, spouts of water shot through the crate work of the temporary canal, the current, running $18\frac{1}{4}$ feet per second on the surface, came swift, still, and irresistible through the ruin, rising to waves 20 feet high beyond it, and swirling in upon the crumbling banks until at last the whole aqueduct was stripped away, and but a part of two of its wings left tottering above the rushing waters. Such spectacles as these testify to the nature of the forces by which the engineer is encountered, and which he must either avoid, or subjugate, or see his work destroyed.

There had been a peaceful interval of quiet years, during which the valley was undisturbed, dry for the greater part of the twelve months, and wetted only to a seasonable degree by the annual inundation to which its peasants trusted for part of their crops, while the sacred city of Kanauj, of immemorial antiquity, sacred because built upon the Ganges and hallowed by historic memories, having been deserted by that restless stream, relied upon its tributary, the Kali Nadi, to maintain in some degree its former state. There was a flood of warning, and then this crisis, when, within twenty-four hours, 20 inches of rain was poured upon a thousand square miles of country, denuded of vegetation by the summer heat, a mass of 1,000,000,000 tons of water plunging down into the valley, with immense rapidity, destructive as a car of Jagganath upon nature's enormous scale. Among the higher grounds the river course was enlarged, as undermined cliffs were peeled off, and banks carved back into precipices. Their spoil was scattered deep over fertile fields below, blocking up old watercourses, while the stupendous stream cut new channels for itself, submerging and erasing villages and their cultivation in superb disdain, wiping out miles of roads and ditches, the masonry aqueduct and buildings yielding as if composed of paper. The tower-like buttressed piers of a great railway bridge were sucked in and swept away, while the rails, with the sleepers to which they were bolted, were left hanging in the air, like a rope ladder with wooden cross pieces, or a clumsily barred spider's web.

And Kanauj? That the river should mock at the moderns and their inventions was not perhaps amazing to the Hindu, whose ways of thought might lead him to regard the event as an outburst of anger from offended river deities, as jealous of the invader as are their devotees, dimly suspicious still of every improvement of the natural order of things. But Kanauj! the twice forsaken! deprived of the tributary as well as the sacred Mother Ganges! How reconcile her position now that the Kali Nadi has been thrust into a new channel miles away? Some legend will surely arise, of rites neglected or demons unpropitiated, to explain and justify the ways of gods to men who may chance to learn its story. But meanwhile, with shrines unsought, with temples deserted, with houses untenanted, it remains a mass of mouldering brickwork, eight miles across, perched on the edge of a barren ridge, from whence the cracked steps of its ghats descend aimlessly to an arid waste below. Its modern inhabitants lived for a time in huts built against its mighty walls, but now the huts have vanished. Having lost the visible favour of heaven, the city has lost that of men also, for the superstitious Brahmans, like the friends of Job, still maintain a strong connection between worldly prosperity and divine approbation. Kanauj, dry, desolate, and deserted, will be soon forgotten as new shrines of happier propitiation arise and grace the distant river's brim; for, if the face of nature change little on the whole, the nature of man also changes slowly. One inundation being past, it is necessary to conciliate the powers that be, so as to avoid another. Dynasties of deities may change, but faith remains. "Kanauj is dead, long live the new Kanauj."

The aqueduct which has taken the place of that destroyed is one of the most magnificent works in India, and indeed in the world, for it is designed to meet all future flood emergencies. The river has been straightened, and the new work based upon 268 wells sunk 52 feet below the river bed; 150 of them 20 feet, 58 of 12 feet, and 56, on the land and river wings, 13 feet in diameter. These, with the foundations, absorbed three-fourths of the expenditure and three-fourths of the time of construction. The total sinking for this purpose occupied two years and totalled 15,019 feet, or nearly three miles, three times as much as in any bridge in India, and probably more than in any single work known. There are three groups of five arches divided by abutment piers, each arch of 60 feet span. The main arches cover 3 acres and weigh 30,000 tons, while the main portion of the aqueduct weighs itself 142,000 tons and carries 31,400 tons of water. Spandrel arches, an arched subway, and octagonal pilasters, add to the architectural effect of this imposing structure, upon which nearly 4,000 workpeople were engaged day and night by the aid of ten electric lamps of 2,500 candle-power for nearly five years altogether. Ships' lascars were brought up to splice the spars of the scaffolding at the great heights required. A railway and sidings nearly 4 miles in length, in addition to a tramway of 2½ miles, were specially erected for the work, the total cost amounted to £445,700, and

the whole was finished within four days of the date fixed four years before.

The following figures, giving a summary of the material employed, may interest the engineer:—

Stone and block	30,000 cub. ft.
Woodwork	100,000 ,,
Pitching	250,000 ,,
Concrete	1,075,000 ,,
Puddle	3,500,000 ,,
Brickwork	4,750,000 ,,
Earthwork	100,000,000 ,,

Compared with the Solani aqueduct the figures are:—

	Solani.	Nadrai.
Waterway	13,000 sq. ft.	21,600 sq. ft.
Canal	1,600 sq. ft	1,400 sq. ft.
Discharge	6,780 cub. ft. per sec.	4,100 cub. ft. per sec.
Length	1,170 ft.	1,316 ft.
Arches	15 of 50 ft.	15 of 60 ft.
Width	195 ft.	148·7 ft.
Depth of foundation ...	19 ft.	52 ft.
Height	56 ft.	58 ft.
Cost	£328,700	£445,700
Time in construction ...	7 years.	4 years.

These works illustrate the grandeur of the scale upon which this system has been constructed, but they by no means represent all the outlay, or all the difficulties which have been surmounted. On the Upper Ganges and earlier canals the workmen had to be taught their business in the first instance, while the engineers had to learn hydraulics. The Eastern Jumna experiment should have warned the latter of the maximum grade which it was safe to give to a canal, but in spite of it Sir Proby Cautley fixed the fall so high in the first instance that costly and elaborate alterations were necessary before it came into proper working order. The fact that this canal is used for navigation always added to its risks. In the first instance another serious blunder was made in dealing with the distributaries, which were designed so as to gridiron the country, without regard to its various slopes, with the consequence that the construction of costly cuttings and embankments occasioned the formation of many swamps. The whole system had to be remodelled, and is only now being completely shaped according to contour, so that while the main canal is carried along the highest level, the channels from it follow the cross ridges of the country to which they are adapted with great exactitude. According to Mr. West rectilinear channels are growing in favour in America, but in India the whole body of judgment is against them, and in every case they are now made along contour lines. The Lower Ganges Canal differs from the older channel in that it keeps to the low ground near the river for some miles, and thus avoids the deep cutting in which the elder begins. There is a certain risk from floods in this practice, but so far it has not resulted in any serious

injury. Training works on the river are dispensed with at Narora, so that there is economy in each respect.

Drainage has always been and will always be an intricate question in the Doab, because of the slight fall of the country. Dealing somewhat recklessly with large bodies of water, the early engineers often did serious damage to low-lying districts, and expenditure upon cuts is still proceeding, so as to mitigate the effects of the thousands of tons of water annually poured upon the soil. The escapes from the canal, utilised to dispose of any surplus flow, have occasioned much anxiety, but it is claimed that in most districts what water is artificially introduced is now provided with artificial means of escape. The swamp lands, due to river overflow or formed after the rains, are not only troublesome, but often fail to repay their drainage, because of the large proportion of salts which they contain. Unless they are permanently reclaimed the work done is lost, and it does not pay as a rule to undertake such a task. Changes in the rivers occasion much anxiety to canal officers, and need to be carefully watched, since they may soon destroy a whole drainage system and ruin, by water-logging, a tract deprived of its former outlet. The drains themselves require to be cleansed of silt and weeds continually, and if much used often cut back dangerously towards the canal.

In 1889 Mr. Nicolls, as executive engineer, was deputed to examine the Fatcgarh district, lying nearest to the Ganges, supplied by the first branch from the Lower Canal, and drained by means of old river channels which intersect it in every direction. It may be taken as illustrating the conditions to be coped with in parts of the Doab. In wet years it lies soaked and sodden, while its people cry for drainage, which can only be partially given them, because of natural difficulties, and of the objection of those below to receive more water in such seasons, when they themselves have already too much. In dry years, on the contrary, irrigation is absolutely essential for its dry sandy stretches. Sugar and rice are grown in the bottoms, where there is better soil and more moisture, the higher land bearing indigo in the summer and wheat in winter. To the eye distinctions in level are scarcely apparent, and the whole area appears an arid plain or a spongy swamp. Add to these troubles those of silt, weeds, and native perversity, and one obtains a fair conception of the ordinary tasks of a canal officer in the Doab, where irrigation is to be seen upon the greatest scale, and in some respects, in the greatest perfection.

Built upon theory, and corrected by experience, the Ganges system, as a whole, represents to-day a capital outlay of £6,100,000, the utilisation of a possible 11,879 cubic feet per second, and in 1889-90 of an actual 5,700 cubic feet per second, by means of 5,500 miles of channels, commanding 2,000,000 acres, of which 1,260,000 are irrigated annually, raising crops valued at £4,600,000, returning a gross revenue of £400,000, and a net return of £250,000. This result was obtained, it must be remembered, when the works at Narora served only to supply the

Fategarh channel, whose capacity is 625 cubic feet per second, and which represents a district of low duty. The whole of the other divisions of the Lower Ganges were supplied from the older canal, which passed down to them, on an average, 2,235 cubic feet per second during 1888-89, against a consumption in its own area of 2,984 cubic feet per second. In its crippled condition, and debited with a large expenditure which had not yet begun to earn a farthing, the system is certainly seen in a most unfavourable aspect. Yet in 1889-90 the Ganges Canal paid interest and 1½ per cent. profit, while the damaged Lower Ganges Canal fell only 2 per cent. short of paying its interest, so that taken together they just about cleared themselves. But for the destruction of the Nadrai aqueduct, and five wet years in succession, there would no doubt have been a surplus to the State after all expenses were paid. It is only now that the new work has come into operation, and an alteration in the returns is confidently anticipated. As matters stand there is no cause for complaint, but nevertheless it is expected that the investment will do much more than recoup the Government for its construction. The cultivator gets a duty varying from 230 to 250 acres per cubic foot per section, paying £57 to £67 per cubic foot per section, or from 6s. to 8s. per acre, on the average. Without this supply he could not grow his most profitable crops in any year, and in bad years could not grow sufficient food for himself or his cattle.

The colossal character of the scheme and of its individual works, its extent and the number of the lives dependent upon it, must impress the mind of the native and the foreigner with the courage and vigour of British rulers. The huge ruins, which attest the power and wealth of the masters of the Egyptians and Babylonians in the past, are mainly those which witness to their superstition, their pride, or their voluptuousness; but if ever in the future another human inundation should submerge India and its governors, those who trace the lines of the Ganges system must confess that they exhibit the qualities of a more beneficent control, and the sway of an alien conquering race, more gracious and wise than that of many monarchs over subjects of their own kin.

CHAPTER XVII.

THE BARI DOAB CANAL.

The Panjab canal system, though modelled upon that of the North-west Provinces, and particularly upon the Ganges Canal, is specially worthy of note, because its works exhibit this class of construction in its most recent developments. Nowhere can the traveller obtain a better conception of the vastness of the interests involved, or of the courage with which engineering skill has faced great natural difficulties in order to serve them. In order to obtain such knowledge it is essential to the enquirer to be furnished with letters of introduction.

India is official in all spheres, existing only in and to departments, each of which is almost a *terra incognita* to its fellows. Only by official courtesy can the inquirer learn anything of their administration. No one is more generously painstaking or considerate to me than Colonel Ottley, R.E., chief of the Irrigation Department of the Panjab, who recently cut short his visit to Australia in order to accept this enviable position, to which he was elevated, on the ground of fitness, over a number of men senior to him in the service. Enjoying a long and varied experience as an executive engineer upon the chief systems of northern India, Colonel Ottley is famed for the vigour of his administration and for the readiness of his pen, as well as for his practical capacity in the field. Nothing can exceed the kindness with which among his multifarious duties he finds time to organise our expedition of inspection upon the chief schemes under his control. His supervision being required in turn from under the walls of Delhi to the very verge of Afghanistan, he leaves Lahore for the Lower Indus and its inundation canals at the same time as my steps are turned towards the mountain ranges from which its tributaries spring. So perfect is the plan which he has prepared that preparations are made for us in advance and at every stage, so that the whole journey upon the Bari Doab and Sirhind systems was completed from day to day and hour to hour with the precision of a railway time-table.

Leaving Lahore from a railway station which in style and convenience far surpasses anything yet constructed in Australia, my first stopping place on my way to the head of the Bari Doab Canal is at Amritsar, the sacred city of the Sikhs, where stands its celebrated

"Golden Temple." Like many other things elsewhere the reality scarcely justifies the advertisement of the name; it is not "golden," but copper, gilt upon its domes and cupolas. It is small in size, some 53 feet square, deriving its beauty from the grace of its proportions, the marble of which the lower part is constructed, and its situation in a tiny lake. The idol worshipped is the Granth or Sikh Bible, before which priests minister all day, and to which the votaries pay homage. The whole of the interior of the building is covered with its verses. The town itself, almost as populous and wealthy as Lahore, is still the centre of Sikh life and aspiration. Here Mr. J. Benton, executive engineer of the district, author of a clever scientific pamphlet on the most suitable form of notch to be employed upon falls, and one of the ablest officers of the department, takes me in hand. Our first stage is by a branch railway to Pathankot, a tedious journey after night-fall, varied by the crossing at times of large branch canals, or the stopping at wayside stations glorified with Bourganvilleas and station creepers. The customary crowds of native men and women cluster into their compartments, chatter and eat sweetmeats. Some step upon the seats and squat there; others roll themselves in their loose cloaks and lie down. The women have one carriage to themselves, and the ceaseless rattle of their tongues bears testimony to a taste for gossip, common to both sexes.

Mr. Benton is monarch of this tract, all of which is irrigated from the great canal, and so at nearly every station one or more obsequious Hindus appear to report upon repairs in progress, or the condition of channels, receive their directions, sometimes as the train moves on clinging to the carriage step for a short distance to catch the last words of command, then salaam and disappear in the darkness. It is late before we arrive at our destination to take dinner, and then set out on foot behind a lamp-bearing chuprassie into the darkness of a little town, as innocent of street lighting as it is of street making. The embers of a few fires indicate houses where there has been a late sitting, and at last we clamber up a steep mound, formerly fortified, into the customary bungalow. My room is bare of all but a charpoy, or bedstead of netted string, a few chairs, a lamp and fireplace, where part of a broken cart wheel and some chips are being blown upon by the barefooted, turbaned, rag-twisted khitmagar, one of whose type is met in every rest-house. A servant unstraps a rug, spreads the zerail, or native quilt, upon its blanket, places a pillow at its head and the rug at the foot, and leaves me to the dying light of the leaping fire, flickering up the high bare walls of white plaster to the cloth ceiling, introduced so that snakes may not drop from the thatch upon the unsuspecting visitor. It is midwinter now, the snakes are asleep, and their example seems worthy of imitation as one lies lulled by howls of beasts of prey in the far distance, from fields beyond the village walls, to which the curs within make intermittent answer by yelps, half in fear and half in defiance, mixed with barking that dies slowly away.

The invariable zinc tub upon the invariable cement floor of the little bath-room awaits me with a chilly embrace in the early dawn. After eggs, toast, and tea, hastily swallowed, we see our trappings tied on the "tonga," and leaving it to find its way around the hill, strike down into the little nest of houses, whose inhabitants are only just beginning to stir. At a junction we hear the monotonous voice of a Muhammadan reciting his prayers aloud before beginning his day's labour, exchange salutations with a cowherd, and are soon in the open country, a barish plain with tufts of bushes, across which the cultivation gradually diminishes. The road is stony but not bad, crossing wide watercourses that head towards the range of mountains to which we drive. With long, loping tread, a jackal, whose prowl near the village has ceased with day, strikes off from us into shelter, some wild fowl rise screaming out of a hollow, and a pair of small deer stand agaze for an instant, and then fly fleetly across a pebbly stretch towards a far-off thicket. Wolves still find harbour here, and occasionally do much damage, while now and then a tiger takes up his abode in the jungle. Then the people turn out *en masse*, and soon make an end of him. The fields which we encounter as we proceed have rude fences for protection, and appear to be chiefly used for growing hemp. The road is for most of the way planted on both sides with jaman trees, in which parroquets are screaming; its becomes rougher as we proceed, meeting a camel or two, and then some knots of Kashmiris from the hills seeking farm work. They have forded the river to which we go, and upon whose banks we suddenly find ourselves, for we have been traversing a high plateau, which comes to an abrupt conclusion where the river has cut its channel, marking the boundary of British territory at the very foot of spurs of the Himalayas, that hedge the borders of Kashmir.

A Rajah of the olden time took toll of those who crossed the stream below in the dry season, and watched the rash attempts of those who ventured to commit themselves to its boisterous waters in flood. His watch tower and the wall of his fort still remain perched on the crest of a jutting crag, where the precipice breaks down 200 or 300 feet sheer to the boulder-edged, pebble-strewn bed, over which the rushing torrent murmurs even now while its stream is low and tame. When the Barons of the Rhine built their castles upon its summits they probably thought of nothing but the security which those heights afforded. Certainly no passion for the picturesque dictated their choice, any more than that of the small Italian towns in the Apennines, or Indian villages in the Maratha country, which one still sees crouching under inaccessible cliffs or hung upon their verge, with lines of wall upon invisible ledges below like fallen necklaces and fortified gates for pendants. The grim old chieftain of Shahpur, behind his 18 or 20 foot wall, could muster his gallant spearmen, or the captives of his last raid, in the great courtyard which it enclosed. His band was housed around it, where now only a family or two find shelter from the winter, and he himself built his eyrie on the very brink of the

precipice, partly that he might the better keep watch and ward, and partly for privacy and security. But certainly in so doing he unwittingly obeyed the genius of the place, and worked in harmony with its nature. Whether he looked forth eagerly from this height, scimitar on thigh and spur on heel, or drowsed in the noonday with the hookah at his lips and his harem door unbarred, he must, although but half consciously, have delighted in the splendour of the scene. Leaning on the light parapet, one looks upon mountains in front and on either hand, for we have pushed up to an angle between them. Behind us is the level plain, beneath us a great valley carved out by the Ravi, which, divided in places into two or more belts of rushing water, winds through a great expanse of coarse sand and cobble stones perhaps half a mile broad. A group or two of travellers are taking advantage of fords at which tribute is no longer levied. Judging from the noise of the rushing water they must still need to exercise some caution in their passage. The hills spring from the farther shore, at first in roughly rounded eminences, and then rise higher and higher to the right in great ranges, behind which lift far-off peaks of snow; before us are stretches of high, sharply cut, glacier clad masses, like Feathertop in July, sweeping to the left with even slopes, in curves of Australian form and hue. Poet and painter might exult, as perhaps a hardy robber chieftain did of old, though at different phases of the spectacle before them, wild and savage in its traits, but of a grandeur to inspire and a harmony to soothe the imagination of an artist.

Leaving the fort we descended by a narrow path, through thorny bushes to the river, where we found two Hindus waiting for us wearing waist cloth and turban only. Each carried two huge empty and inflated buffalo skins, carefully sewn up and oiled—shapeless bladder pontoons looking like deceased hippopotami. Two of these were placed parallel to each other, with heads down stream, the stumps of the legs up, and an oblong string netted bamboo frame was tied in position across them. Upon this we squatted, our weight bringing it down to within four or five inches of the water. Except that it had neither back nor rail it made a comfortable seat. Each of the natives then entered the river, lying across a separate skin, his legs in the water, his chest and body resting upon this float, and holding our *surnai* (as the raft is called) one on each side, they acted as steermen, rudders, or porters as the journey might demand. No propellers were needed, for the river was running four or five miles an hour, in its ordinary course, and at least twice as much down its frequent rapids. Some judgment was required in shooting these to prevent our striking upon a rock or being whirled against cliffs at the side. The consequences were more likely to be dangerous from bruises and breakages than from drowning, as at this time the river was rarely more than a hundred feet broad and often much less, on its separate arms, with a depth ranging from two feet to eight feet or ten feet. On these upper portions it much resembles the Po, but enjoys far finer surroundings, and fills with fiercer floods much oftener than the Italian

river at the head works of the Cavour canal. The fall of the Ravi is about 25 feet a mile, and as even at this time of the year the water comes from snowy regions it is blue, cold, and perfectly transparent.

We start with an easy gliding motion, our crew keeping us well in the centre of the stream. Presently we travel somewhat faster, and have the wrinkles in the water, between strips of glassy smoothness, darkening to tiny waves, edged with white foam, to warn us, if the noise does not, that we approach a rapid. We are steered to a point where the flow can catch us fairly. Our men poise themselves for emergencies, and in an instant we are seized in the strong grip of the current, and shot with harrowing swiftness down the turbulent incline, rocking in the swell beyond and balancing a little nervously as now and then a splashing wave shakes its spray over us. There is really no risk, and something of the joy which belongs to steeplechasing and tobogganing, in these flights down watery slopes and into the eddies below them. A wooden or even an iron boat would be less safe, and far more likely to come to grief than these simple skins, for when we did touch a few times the deftness of our amphibious supporters enabled us to get over reefs which would have dashed a stronger craft to pieces. After the first few moments we became adapted to the motion, and enabled to enjoy the scenery as it unrolled before us, while the sun grew bright and warm, the wind came fresh and keen from the snow fields, and the river leapt and danced in its shallows as if at play.

Although we had taken to the stream high up, we had not been high enough to witness the first guard set upon the river, which is capable of strife as well as play, and needs at all times the wariest supervision. Ten miles above the headwork is an automatic gauge communicating with an electric wire, which, immediately upon a rise or freshet, sets a bell ringing in the office of the engineer in charge, who at once makes preparation accordingly. Sometimes the river comes down that ten miles in three quarters of an hour, a quarter of a mile and more wide, carrying great trunks of trees as easily as it does straws, and even rolling its boulders along at no inconsiderable rate. Having so wide a bed to choose from, it selects fresh courses, and thus threatens to approach the works below at a new angle, perhaps silting up the canal side altogether, leaving the offtake high and dry, while in its concentrated fury it assaults the further bank with liquid avalanches. It becomes necessary, therefore, to begin to control it far up, and our first stoppage on our voyage is to note the condition of a temporary dam, part of which has been carried away recently. We find it to consist of crib work (frames filled with boulders), faced with brushwood and stone, from five feet to eight feet wide and 1,400 feet long. The old work of wooden piles had given way, as this was expected to give way, having served its turn. It had now been determined to make the protection permanent, and plans were approved for a 1,200 feet stretch of masonry pitched with boulders. There are

already five miles of training walls constructed, and it looks as if the whole river in course of time would become studded with bunds like the Ganges above Hurdwar. The cheapness of labour here has an immense influence upon this class of temporary structures. The one before us is an excellent piece of rude but stable work. In Australia it would have cost at least three or four times as much as it cost here. The fact that some water is already taken off upon the Kashmir side occasions a difficulty which is likely to be increased if the larger project upon which Mr. Benton is about to report to the Government of that dependent state should ever be adopted. The construction of these training works is a feature which we in Australia may need to copy to some extent. Everywhere in India the rainfall is liable to be heavy and sudden, so that their construction is a necessity north and south: but it is upon Himalayan rivers and at the feet of their gorges that the struggle is acutest, assumes enormous proportions and taxes all the resources of the engineer to cope with mighty overflows.

We are piloted diagonally across the stream at this point to the lefthand bank, where a village of straw huts indicates the presence of natives. They are Changras or gipsies engaged under contract, or rather by piece work, to make a cutting which shall divert the river temporarily for the construction of the new dam, and it is hoped permanently by means of it. They are allowed to pick their own hours, and hence have not yet commenced their day's work, for the air has still a morning chillness. Some magnificent trunks of pine and deodar have been stranded by the last flood, and and a little knot of the chief men are waiting by them for our arrival. Salaaming humbly, one or two of the grey-headed elders, patriarchal in visage as in garb, and somewhat Jewish in featnre, solemnly commenced to speak with dignified deliberation and grave decorum, enforcing their remarks by gesticulations of a calm and graceful kind. Mr. Benton endeavours to cut them short, and succeeds until a fierce looking younger man bursts into impassioned speech, standing like a new John the Baptist raising his spare figure, and wrapping his cloak about him with one hand, while with gleaming eyes he lifts a lean forefinger to the skies. It is disillusioning to learn that all this oratory is merely a plea for free hand-barrows. The suppliants appeased, we visit the cutting which is being made without them by means of the short hoe and hand basket. Women as well as men take their share of the work, for which they get 9s. to 10s. per 1,000 cubic feet. The Changras are wanderers, traversing the country in search of work of this kind, and setting up their huts wherever they can obtain it. Their head men enter into agreements for them, and, being a stalwart, industrious race, they are enabled to earn what, according to the native standard, are good wages.

Taking to our surnai again we pass numerous little straw built flour mills, the size of cabins, and at last stop at one of them. The water taken out of the river by a race, mining fashion, is carried along the bank until a fall of three or four feet is obtained, when

the stream is divided according to the number of stones (from two or three to six or eight), and rushing down small channels turns a little wooden wheel with longish blades placed horizontally below; this by means of a perpendicular pivot turns a millstone in the hut above, resting upon a second millstone through which the pivot passes; between these the wheat or Indian corn is ground. The mechanism is simple, but not effective, only utilising 25 per cent. of the water power as against 80 per cent. that would be available from a turbine. The cabins were fairly clean, but so low that one could only stand upright under the ridge pole and could then touch the walls on each side; yet these sufficed for the abiding place, store house, and workroom for several natives during the season of low river, which enables them to grind and earn their bread. After we leave these the stretches of the Ravi are interspersed with rapids running under cliffs, which rise higher and higher. A canal was once excavated along them to supply the distant township, but a high flood reached the first section of it and swept it entirely away. There are no habitations visible from the water line, but evidently there are hamlets beyond the banks, since women here and there descend to fill their ewers, or hemp is seen in soak. At last the massive piers of the sluice and intake, the long line of the weir and a few buildings upon the bank appear in sight and grow nearer, until our skin raft is run to the side, and we leap ashore to climb a high bank and gain the bungalow upon it, welcomed by the engineers in charge to Mahdipur.

These bungalows or rest houses are built every few miles along the canals for the accommodation of the officers, a great portion of whose time has to be spent in the open air, or in immediate proximity to the several parts of the scheme under their charge. There are neither hotels nor dwellings habitable by Europeans in the country, and it proves to be cheaper to erect these cottages with a few large, bare, lofty rooms, and a few simple articles of furniture, than to provide for a movable camp such as requires to be employed upon long reaches of less important canals. Each officer receives a small travelling allowance, and carries his food and servants with him, finding a caretaker in the bungalow to assist in its preparation. We camp comfortably enough that night, glad to warm ourselves before a log fire, for we are 1,200 feet above the sea in the midwinter of the most northerly part of India. There are one or two white residents in the neighbourhood, who are visited by a clergyman once a month, so that we feel in a comparatively populous and civilised community. A native town lies at a little distance, which still enjoys a fair share of frontier trade, and reaps a steady benefit from the large gangs of men engaged upon the headworks and the canal. But for its staff there would probably not be a white within a hundred miles of the place. There is nothing in the neighbourhood to indicate any necessity or even use for this great work, undertaken to supply a distant tract, occupied by native cultivators only, the pioneer enterprise of its class in the Panjab.

The Bari Doab Canal was the first great work undertaken here

by the British Government, and occupies in that regard the same relation to the other canals in the province (always excluding the Western Jumna) as the Ganges canal does in the North-West Provinces. Although it had the advantage of the experience gained in the great enterprise of Sir Proby Cautley, the same mistakes were repeated in its construction to a minor degree, and it was in some senses an experimental undertaking. It is but fair to note the special conditions under which its commencement was authorised, since these go a long way towards explaining certain of its features and accounting for its subsequent career. If space permitted, it would be advantageous to give the history of each of the Indian canals in full, and indeed without such knowledge it is simply impossible to judge them fairly or estimate their special lessons. The hand of the Government has been forced in connection with many of them. Their gradual developments are also pregnant with significance, and the manner in which natural forces assert their supremacy, enforcing the adaptation of all works of human hands to their caprices, conveys a warning which cannot be too often reiterated in a country like ours, which is still in the incipient stage of irrigation enterprise. We have the opportunity in Australia of beginning upon the right lines, and of shaping our schemes at the outset in those forms which they must assume before they can be considered completed, no matter at what expense they may be inaugurated on any other plan. On these cardinal points it will be much cheaper to learn from the mistakes of others than from our own. It may be taken as certain that, even if we avoid initial errors, we shall soon have a crop of minor blunders from which our engineers, like their Indian compeers, will learn by bitter and costly experience that there is but one right way, and that they must find it as soon as possible.

In the middle of the seventeenth century the Emperor Shah Jehan, always magnificent in his designs for public works which ministered to his personal comfort or his appetite for display, constructed a canal 110 miles in length from the Ravi to Lahore, in order that fountains might play in his private gardens. This was afterwards employed to some small degree in irrigation; and when the Sikh power was established the tank about their temple at Amritsar was fed from it by means of a branch channel. The canal was gradually improved until at the time of the annexation it was 30 feet wide and capable of carrying 500 cubic feet per second. This quantity was not available during part of the year, though at times a great deal more water found its way into the canal than it was capable of carrying or disposing of, and consequently wrecked its inlet from time to time. Nevertheless the canal produced a direct revenue of £85,000 a year, and as much more indirectly from land revenue. There was no regulator at its head, the diversion being accomplished by means of a temporary dam of gabion work, 610 feet in length, constructed each year upon a branch of the Ravi, now resting upon a low and shingly island. In 1850 the river cut round the right flank of the dam and through the island,

at the same time making this its main channel. The Husli, as the canal was called, still exists, but being crossed by the European work a short distance down, its upper part has been used mainly as an escape channel back into the river through its old inlet. From thence it takes a tortuous course across the drainage line of the country (protected formerly from the incursions of the Jennah and Chukki torrents by boulder dams, which required yearly renewal), and with leaky spots and bad alignment gets at last into low ground in a clumsy way. It is now proposed to correct the laying out of this canal, and render it a permanent adjunct to the splendid scheme which has supplanted it for the last 30 years.

Immediately the British influence became potent at Lahore, Sir Henry Lawrence induced the then Government to set apart £30,000 a year for the improvement of roads and canals, realising with statesmanlike wisdom that the surest means of correcting the roving military spirit which consumed the people was to attach them to the soil. This was impossible without irrigation, and when the second Sikh war was followed by the annexation of the country, it became even more urgent that the means of agriculture should be multiplied without delay. It was at first proposed to commence the great canal in the Doab between the Ravi on the one side, and the Beas, with its recipient, the Sutlej, on the other, in order to find employment for the disbanded Sikh soldiery, but the excellent harvest which fortunately followed in 1850 removed this necessity, and allowed the scheme to be well digested by Lieutenant (afterwards Colonel) Dyas, to whom the credit of the original design belongs. Nevertheless, the anxiety of the Government to tempt the Sikhs to settled pursuits led to the work being adopted and pushed on without delay. A difficulty arose from the want in the Panjab of skilled artisans capable of undertaking the important portions of the plan, and even of navvies willing to do earthwork. The Sikhs are too proud and too martial to accept a workman's hire, not condescending even on their own fields to do more than hold the plough, and paying labourers to do the rest of the farm work.

Here, as in the North-West Provinces, the masons and carpenters had to be half trained by the engineers in the first instance, while the excavation cost one-third more than upon the Ganges canal. Coolies, who could be obtained for 2¼d. a day on the older work, required 3d. a day in the Panjab, and did but two-thirds of the work. Masons, though no more efficient, required 30s. instead of 20s. a month. Bricks were three times as expensive, there were no lime deposits as there are in the Ganges Doab, and but one ruin from which old bricks could be obtained and ground for sand, the fort at Pathankot, while in the other district the plains were dotted with the available remains of cities and palaces. The Bari Doab has no works so architectural and no structures so bold as the superpassages and aqueducts in the Ganges canal, but for all that its dams, with masonry regulators, its rock cutting, in one place 200 feet in width, and its 326 feet of fall to be provided for as against 107 feet in the former, taken together with its more expensive

labour, rendered the cost proportionately as great as that of the superb canal of the North-West Provinces by which all others are proud to be measured. Nowadays the circumstances have been greatly altered in the Panjab; good workmen are not rare. while carpenters and fitters from its districts are preferred even in the North-West Provinces. The mere recapitulation of these few incidents during the progress of the early stages of the works may serve to bring out the difference between the wages and conditions prevailing in India and those with which Australians are familiar. They assist also to enable us to understand the obstacles to a cheap and speedy success. and the determining circumstances of the Bari Doab scheme. The fact that this canal would traverse the centre of Sikhdom, supplying Lahore. Amritsar. and their neighbourhoods, and watering the fields owned by the flower of the nation, led to the choice of the scheme and its persistent development, in the face of all difficulties.

Commenced in 1850 with an estimate of £528,000 for 500 miles of channel intended to carry 3,000 cubic feet per second to 654,000 acres, to be charged 5s. per acre, and to return a profit of 27½ per cent., the ultimate realisations have differed from the project in every particular. Attention was at first concentrated upon the Lahore branch, which takes off from the main channel 24 miles from the river, and by 1856, when this was still in progress, the estimate of the whole had been more than doubled, amounting then to £1,400,000, while the expectation of profit had fallen one-half, though in other respects the plan remained as before. In 1859 part of the scheme was opened, when the Ganges canal experience was immediately repeated, and the bed of the channel, in consequence of the extreme fall given, was cut out by erosion further and further back, to the serious danger of all masonry works. In 1868 the river threatened to make a new departure in its course, so that entirely fresh headworks had to be constructed, and a dam thrown across the main stream to feed them. In 1870 there was still much to do, both in the way of improving the existing canal and of its extension. In 1874 the scheme was finally revised, the irrigable area being reduced to 543,000 acres, and the calculation of profit to 8 per cent. By the time that these amendments were carried out the works were paying 1 per cent. upon their capital. By 1882-83 the condition of some of the channels was more critical than ever, for though expedient after expedient had been tried to prevent erosion they were without success, and there seemed a possibility that one or two of the more important branches would be rendered altogether unfit for working. These defects were gradually remedied, but only so as to maintain the *status quo.*

In the meantime the volume of the Ravi, which had been soon found to be beneath the calculation upon which the scheme was based, threatened to fail. It became a question as to how an additional supply might be secured, given the knowledge that if it was introduced into the canal as it stood it would probably wreck

a large part of the works. Despite these complications the task was attacked piece by piece until the scheme was rendered capable of meeting the demands. It cannot be said to be yet perfect in all its details, but at least it is within measurable distance of completion, and has gained a high degree of efficiency. Its capital cost to 1889-90 was £1,640,000, its yearly proceeds £182,000, working expenses £60,000, gross profit £121,000, or 7.39 per cent. net profit, after deducting interest at 3½ per cent., amounting to £58,000. The canal has paid off by a series of surpluses the losses of its earlier years, and is now contributing to the general revenue towards a sinking fund. It irrigates 523,000 acres at an average of 6s. 8d. per acre The cubic foot per second waters 65 acres in summer and 169 acres in winter, or 234 acres in the year. Besides the Mian Mir cantonment there are 1,352 villages enjoying its supply upon their fields, and slaking their thirst and that of their cattle at its flow. This is the final result of a gallant struggle of 30 years, for many of which the prospects were certainly not propitious, and might sometimes have been deemed hopeless, even by those to whose charge it was committed. In Victoria there are endless jeremiads if a public work is not faultless from the start and remunerative from the instant it is opened. Anglo-India appears to have more courage and more confidence in its professional men, and assuredly the banks of the Bari Doab can bear witness to an uphill conflict carried on unflinchingly until it was crowned with victory.

At Madhopur a most remarkable illustration of river freakishness is presented in the shape of two sets of head works in perfect preservation. The first was simply an offtake from the river, consisting of two brick bridge regulators, united by a handsomely rounded masonry mole of fine proportions. The regulator on the right was intended to serve as an escape in flood seasons, allowing the volume of water not required by the canal to flow down an old bed back into the main stream. It is a fine structure of 21 arches, of which three are permanently closed, and only six open, and these rarely used. As first designed, it was to have had 37 openings, afterwards 28, but might have been omitted entirely, as events proved. When inspected by me it was divided from the canal by a dam of cribwork and earth, the end of which had been carried away, and though a line of coolies were throwing branches and boulders into the gap, the clear green gleaming stream of water, 3 or 4 feet deep, whisked them away like straws, and must evidently eat away the bank unless the whole intake was shut off at the new regulator. As the canal had a sufficiency, and as there was no particular demand upon it at the time, the little accident was regarded with equanimity. The abandoned outlet was formerly the river channel between an island and the bank, but had been so long disused that grass grew and cattle were grazing in the bed. When it is closed the river sets straight against the curve of stonework which divides it from the inlet, and pours down the canal. A brick bridge regulator at the mouth still remains with

nine openings of 13 feet 3 inches, but its gates hang stiffly and are in parts touched with the green growth which tells that they are rarely moved. Some of the front stonework of the piers has gone too, but the work is sound as a whole, and capable of use in an emergency. It stands at an obtuse angle to the outlet, guarding the inlet to the main channel, which runs for some distance between banks 60 feet high, pitched below, terraced above, and crested with trees. The excavation is immense, the finely finished works that front it are graceful, as well as strong, and with neat parapets make a worthy entrance. At present their chief use is to keep out shingle, and, indeed, it would not be difficult to dispense with them altogether, for though intended to serve as headworks to the whole scheme, their use is now subsidiary.

The present headworks are a little way farther up the river above the island, where they grapple boldly with the Ravi in its main bed. Here, at right angles with the stream is the brick regulator, carrying a bridge some 15 feet wide, which governs the intake of the canal. It has 23 openings of 10 feet each, closed by gates raised by a movable crane running upon rails. The water flows swiftly under it, passing between the island and the bank, to the old regulator and the deep cutting, carrying considerably more water than the Yarra does for the greater part of the year. The body of the main river, except when at its lowest, passes through a lofty and massive escape, 20 feet high, having 12 openings of 20 feet in width, with two sets of gates, one above the other, 5 feet and 3 feet in height respectively, stretching out into the stream. It is also a bridge leading to the line of lower weir beyond, 3,000 feet in length, which stretches right across the valley to the Kashmir side, composed of solid stone work with a vertical face, and slope to the rear. Over this the Ravi runs in flood season, but at all other times is passed through the new inlet and outlet in due proportions. The weir is 6.36 feet and the sill of the canal 2 feet above the outlets, over which in the rainy season the river runs 15 feet high, and just above the works comes down a mile wide. Nor is it merely the water which requires to be dealt with, for in three years it deposits 14 feet of silt and shingle, the clearing of which had cost £3,000, even with native labour, just before my arrival.

But the chief brunt of attack is borne by the upstream face of the main outlet, against which boulders are hurled like cannon shot and trunks of trees whirled like battering rams. One of the engineers has seen stones spring like fish out of the furious currents. An old sluice bridge was crushed under the pressure of a mass of logs and driftwood which collected for half a mile up the river, backing its waters until the structure gave way all at once, and disappeared, as the pent up stream, with its tremendous burden, burst away in a cataract of littered foam. Five of the outlet piers project before the others, and are armour-plated, with wooden sleepers upon their rounded fronts, riveted perpendicularly with strong iron bands. Above these are iron greaves, the dents in which are eloquent of the blows they are required to sustain, even to that height. No un-

covered masonry could endure the shock of mighty Deodars whirled along the crests of waves at the rate of 20 miles an hour. The first piers serve to turn them when they come down on the broadside, while the second line are protected in their turn by shields of a similar kind.

As this is the quiet season for farmers and the river is low, a temporary coffer dam of boulders and earth, 15 feet high and 5 feet wide at the crest, has been built in front of the outlet, which is thus rendered dry. We descend and find that it is floored with 1 foot rubble-boulder masonry, stones of the toughest character, which have best resisted the tempestuous journey from their native hills. strongly laid in mortar and strengthened by partition walls of 2 feet boulder masonry set in cement. In the first 69 feet of apron through the outlet the floor drops 1 in 15 to a partition wall, then rising 1 in 10 for another 65 feet to another partition wall 10 feet deep, and afterwards bearing away at a level 5 feet lower than the outlet floor. The whole is strengthened by a retaining wall of masonry, 312 feet long, turned 35 feet into the bank, and 700 feet more, built of rubble, protecting the canal bank. Above the work the banks are pitched for 20 feet high on the same side. Standing upon the outlet or better still upon the river cliff above, one sees at a glance the vigour and variety of Indian engineering work. A river which from May to October carries an average of 10,000 feet per second, and which at times rages and rushes from bank to bank, here swirling across the great valley like a mill race, and there seething like a boiling cauldron, is no despicable opponent. Faced miles up with training works, which serve to confine its fury or direct it into certain courses, it is here boldly seized by the throat, and while its waves tear over the long line of weir its deepest and strongest current is controlled and swallowed by the outlet. Whatever part of it is necessary is then sucked by the inlet, passed down to the old headworks, and either dismissed by the escape or let flow steadily into the placid reach of the canal, upon whose evenness and regularity the lives and fortunes of thousands of villagers depend from year to year, the whole of them probably equally incapable of conceiving, constructing, maintaining, or appreciating the works to which they owe their daily bread.

When I see it some five or six hundred Changras are busy in and about the outlet, and upon its dry floor, protected by the dam; men and women working patiently, quietly, and politely one with the other. The women who do most of the stone carrying upon their heads, are barefooted, unbonneted, with a handful of rings and pendants in each ear, which is perforated and stretched from top to lobe, so that the face sometimes seemed half framed with silver filagree. They wear short jackets, shoulder capes, which cap each breast, and petticoats to below the knee. By one of the curious caprices of feminine fashion, while they carefully shield the bust, which some civilised women expose, they are perfectly indifferent about the waist, the whole of which is usually bare. The males wear a loin cloth and body garment, the masons resting on their

hams as they chip stone or mix mortar. The soil is carried on the head in coarse plates like baskets, chiefly by women. Knots of men are busy repairing the floor just below the regulator, taking out the damaged blocks and stacking fresh ones ready to replace them.

It is a never to be forgotten lesson of the force of water, and the burden of shingle which it carries, to see this massive floor of specially hard Delhi quartzite boulders, worn as a macadamised road would be under heavy traffic if repairs had been long neglected. The stream has cut in places through what is equal to solid rock, in gaping ruts and fissures like those which still show to-day how the Roman waggons pierced more than a foot deep into the soft pavement of the streets of Pompeii. Here and there the stone and cement have been riven asunder, and in other parts a cyclopean eddy has eaten a great hole right through the masonry crust. The floor face is almost as uneven as coast rocks uncovered by the tide, full of heaps and hollows, created within three years. Formerly there was a vertical fall into a basin 25 feet deep behind the outlet, but the turbulent water circled in it with such violence as to cut back most dangerously into the wings. A perfect floor had been put in, as it was thought, once and for all, and now it, too, required to be renewed, with the certainty that it would need replacing every few years. The toughest stone and best cement, though united in the most approved form, were incapable of resisting the giant strength of the Ravi in the fury of its yearly floods, and under the grinding force of its crushing burdens.

An early morning start with the tonga takes us many miles along the canal, from its deep cutting to where it emerges into the level country and strikes out through the plains. The earth banks everywhere are flat topped, and carry a road for repairs, and for transit by officers and neighbouring Jats. Beyond them and along them the strips of land belonging to the canal are all planted, and made to contribute towards its revenue. Every three or four miles are masonry footbridges, generally built in connection with a drop of some kind. Occasionally we come upon mills upon the banks, and pass the cultivators on their various errands to the little settlements, which are few and scattered here, because in this part there is little irrigation, though it begins after the first three miles. The chief and most characteristic features of this section are the rapids which are met with at short distances, and which are peculiar to this scheme. One of the difficulties which confronted Colonel Dyas in designing the Bari Doab Canal was the great fall of 326 feet to be overcome by artificial means; three times as much as that upon tho Ganges canal. He provided a slope to the first mile of the canal of 18 feet, and of 6 feet for each of the next 10 miles, with 29 falls or rapids upon the main line of 53 miles, and slopes of at least 2 feet a mile for its distributaries. His plan for the first 12 miles proved feasible because the channel was cut through shingle, but proved far too great below. The bed was cut out, the tail silted up and the bridges everywhere threatened with destruction. When, some years after, Colonel Ottley, then an executive engineer, took

charge of the main upper branch, he found that temporary weirs of crates had been employed in many places for the protection of the masonry, while the use of stakes had been so frequent that they formed a small forest in the stream. Colonel Crofton was the originator of the idea of rapids instead of vertical falls, though they did not receive their present character until Colonel Hume and Colonel Ottley perfected them in 1886.

It is unnecessary to criticise them at length, as it is extremely unlikely that they will ever be adopted in Australia. They consist of dry filling, stone or shingle, packed closely from 3 feet to 5 in thickness, sustaining a foundation of 1 foot of concrete or rubble masonry, over which 18-inch boulders are set on end, with a crest of ashlar stone 2 feet by 1 foot, pointed with cement. The whole is given a slope of 1 in 15, and divided into compartments by longitudinal and cross walls about 30 feet apart, the upstream return walls having an angle of 45 deg., the down stream at right angles, and the banks and bed of the canal being pitched from 150 feet to 300 feet with training walls of half that length. All the rapids are identical in form, but advantage is taken of their number to try many experiments, of which the present type is the outcome after years of experience. Some of the rapids have below them what are called reverse flows, which slope up from a cistern into which the stream pours, and thus break the velocity of its onset down the canal. At No. 13 there are three of these, and in consequence three waves of some size are created with a circling back wash, which is thought too violent for safety. Rapids certainly diversify the quiet stillness of a canal. There is a rush of water under narrow foot bridges, and the gleaming face of the stream, as if of polished glass, reflecting on a small scale the same sheeny tints and swift witchery of motion as is to be seen on the Canadian bank just above Niagara. The bewildered play of foaming water over boulder teeth, which show distinctly through a transparent veil of cascade in its first leap downward, and the turbid bubbling confusion of darker hue below, impart a dash of piquancy and buoyancy to the otherwise dull and sluggish stretches of the huge, unlovely ditch.

The advantages of rapids are that near the river, with its inexhaustible supply of boulders, they are cheap; that where there are bad foundations for masonry they are sufficiently strong for the velocity of a canal; that they can be constructed with rapidity, and that they are repaired with ease and quickness during the annual stoppage of the flow. Nevertheless Mr. Benton and the younger school of officers prefer the vertical fall and a cistern of full size under ordinary conditions, and only accept the rapids when compelled by local circumstances While the cistern of a well constructed fall emits the water at little more than the ordinary velocity of the canal, the rapids increase it considerably for a short distance, so that it requires to be diminished again by artifical means. An ingenious device to reduce the velocity of the water on falls was introduced by Colonel Dyas, who barred the crest of his weirs so as to divide the flow into a number of jets which fell with

diminished force; but the work was expensive in the first instance, and as the gratings needed constant cleaning it added to the cost of management. They have now been finally abandoned. There are other works upon the canal full of interest to the engineer, though to describe them would be tedious. For eight miles it is protected against cross drainage by a wall and ditch; one stream is taken through it by means of three regulators at its inlet, outlet, and across the canal, while some distance back two torrents which formerly crossed the line are diverted by deep cuttings into the watershed of the Beas. The distributaries are studded with rapids, and have bridges at every mile, together with regulators and escapes, so as to allow of complete control of the water. All along the banks the villagers not only obtain their supply from the canal, but wash their clothes and bathe in it continuously. The knowledge of this does not prevent the stream from being made the sole source of an unfiltered supply to the troops of the Mian Mir cantonment. This is the one utterly discreditable domestic supply in India. It is true that the Hindus are fairly clean, but they are made so by frequent ablutions, and even in the day time one often sees them, always with the waist cloth on, enjoying a bath in pool, tank, channel or river.

We ate as well as slept in the rest houses or *chokis* along the canal, where Mr. Benton had a busy time with his sub-officers and with crews of native watchmen, patrols, contractors, village headsmen or others attending upon him with complaints, reports, or tenders. No one could be personally less pretentious or official than he was; and yet, seated at his little table, twirling his dark moustache, and with his keen penetrating eyes fixed upon the knot of obsequious Panjabis approaching with the bowed head of humility, awaiting his pleasure with reverential aspect and doglike patience of appeal, and addressing him with hands clasped before them as if in prayer, he was emphatically the type of a conquering race. He had the pose of a Roman consul, too indifferent to despise the aliens who stood before him, accepting them as treacherous and untrustworthy, without annoyance, and quietly but determinedly compelling them to do his will. Out and about the canal he paced with his little troop of followers, ever attentive, ever watchful, ever plausible, ever undecipherable, trotting at his heels, accepting his commands, repeating them to each other in explanatory half-whispers, and salaaming profoundly as we drove off to the next *choki*. For 28 miles the canal is over 120 feet wide at its surface and 112 feet in the bed. This supplies six or seven main branches, from 50 feet to 80 feet in bed-width where they take off, reduced to from 20 feet to 60 feet at the tail. Out of these run distributaries, from the distributaries village channels, and from these the drains for field supply, so that this scheme covers some hundreds of square miles of country, and would appear to a bird's-eye view like the underside of a large mulberry leaf, intersected with greater and smaller veins, branching the one from the other, and spreading to every part of it with a fine tapering net work through which nur-

ture in due proportion is conveyed to each cell and fibre. It is, perhaps, the highest praise of a great human achievement like the Bari Doab system, to say that in completeness, order, adaptability, and harmony it is coming at last to rival the work of nature herself.

To me its headwork at Madhopur must ever be associated with another image to which, past days of eager interest and evenings of cosy chat, memory returns in awe and wonder. This was a solitary vigil, when a sunset was seen from the high bank beyond the roadway, by its border of full foliaged trees. A precipitous cliff overlooked the long spread of the valley—pebble, sand, and clay, white, russet, and yellow—through which, in steely blue ribands, edged with fretted foam, the Ravi came, repeating in hoarse monotone the song of the myriad pines, beneath whose shelter it had commenced its wild career. Far up the river its borders glittered with tints of salmon pink dropped from the glowing sky, and down below glimmered in deep hues, where the dispersing knots of Changras turned slowly homeward from their work. Away under the forest-clad hills of the further shore the sombre shadows of the evening gathered peacefully, beneath the skirts of a light purple mist that crept stealthly onward, between grey shingle and yellow grass, to a eucalyptus grove planted in rear of the canal inlet, which caught the rays upon its familiar leaves of sober green, as if with a flush of recollection of their far off home, by reaches of the Upper Murray or slopes of the fern-fledged gullies that enshrine Mount Arnold and the Black Spur. A veil of white cloud, mottled in mackerel scales, lay lightly on the blue sky, whose sulphurous sweeps of semi-transparent lustre deepened here to tawny gold, and there burned to a sparkling intensity of incandescent crimson, like the molten flow from an iron forge seen in the darkness. But most beautiful of all, beyond the great gorge where the river ran, was the mountain arc with its gigantic curve broken by peak, horn, pinnacle, and crevasse, against a background of limpid azure and soft sea green; its glaciers and their kin shining with reflected radiance, glowing with tenderest ruby tints, and softened tones of blushing light—an aureole falling from the cathedral windows of the heavens—an aurora such as sometimes glistens to the southward of Australian skies, lifted here to Himalayan heights, and scattered free for half a hundred miles, among the cloven hills and along the virgin snowfields of Kashmir.

CHAPTER XVIII.

THE SIRHIND CANAL.

The Sirhind canal to-day occupies in some aspects the pride of place among all the canals of India, for it has the greatest width, if not the greatest length, or supply, and represents the largest investment of capital in any single undertaking; it waters an immense district, which prior to its construction was always sparsely peopled and impoverished, and rivals even the Ganges canal in the magnificence of its structures and the greatness of the difficulties which it has surmounted. Built after it, and after the Bari Doab, it benefited by the experience gained upon them, and represents to-day as high a degree of efficiency as either. It has yet another claim to distinction, which belongs only in a minor degree to any other canal, and which formed the subject of Lord Ripon's remarks when declaring it open in November, 1882. One-third of the cost of the canal was contributed from native states whose territories its branches enter, a circumstance which induced the Viceroy to say that the princes of India could make no better use of their wealth "than by employing it to promote undertakings of this description, and they could take no surer means of winning both the loyal attachment of their own people and the grateful thanks of the Government of the Queen-Empress."

It was to this canal that, after inspection of the Bari Doab, the forethought of Colonel Ottley sent me, and again I was especially fortunate in being the guest during the tour of one of the ablest engineers of the province, and indeed of the service. Mr. A. G. Reid had not long returned from Africa, having been lent to the Egyptian Government for five years, and entrusted by Sir Colin Moncrieff with the direct charge of the repairs to the great Nile Barrage, whose two wings, each 1,500 feet in length and 63 feet high, built upon Nile mud, after lying almost useless for many years were restored to effective working and rendered capable of retaining 16 feet of water by the skill and perseverance of Indian engineers. For his part in this great achievement Mr. Reid had the honour of being decorated by the British Government. A most capable and courteous officer, he was also a man of travel, reading, and reflection, as entertaining and instructive a companion as one could wish to have. I joined him at Lodiana, his headquarters, a city of 40,000 inhabitants, in which there were but two whites re-

sidents besides himself, and each of them frequently absent on duty. A fourth was 50 miles distant, and helped them to represent British ascendancy over 1,200 square miles of country, not given over to grass and sheep as in Australia, but populous with alien races, living their own life and pursuing their own ends, under the shelter of British law and the terror of the British name.

It was nearly midnight when we reached the canal at Daroha; our luggage was lifted to a trolly, upon which a couple of chairs were placed for us, and then we were run along a tram line by a band of attendants. Of course, with true Hindu thoughtlessness, they had neglected to set the points, and the consequence was we were suddenly derailed and compelled to undertake the rest of our journey on foot. Through the starlight we could see battalions of mammoth logs, ready for sale, piled in lines, by means of the tramway, on an open piece of ground. All of these were Deodars, cut by the Forest Department in the Himalayas, slid down the mountain side to the stream, floated thus to the Satlej, and from the river down the canal, to where we saw them lying arranged according to quality, and of all sizes, from 18 inches to 4 feet in diameter. There were 17,000 logs marshalled in the gloom, and 26,000 sleepers piled beside them in the depôt. Passing these we found our way to the water's edge, and across a plank into a large canal boat, in the centre of which stood a single room for cabin; behind it was a brazier, with a knot of crouching natives about it, who rose and bestirred themselves at our approach to cast off the ropes. The only beds were two hinged ledges against the side of the cabin, supported by a couple of iron rods. Spreading a rug upon this, with my boots rolled in clothes for a pillow, and an overcoat and a rezail for coverlet, not even the hard couch could prevent me, after a long day's travel, from adding one more to the total of the sleepers in that neighbourhood.

There were noises in the night floating faintly to my ear with a sense of sea motion, interrupted for a few moments as for stoppage now and then. The morning light was clear, though the air was chilly, when mounting on the prow I made the acquaintance of the Sirhind canal by a plunge into its waters. Fortunately, the boat had stopped, or else it might have been difficult to regain it, so strong was the current in this fine artificial river, 200 feet wide and 7 feet deep. After a short swim against it I was glad to clamber in at the stern and secure a rough towel. Breakfast over we had our chairs lifted upon the little platform from the cabin to the bow, basking in the sunshine and enjoying glimpses of scenery along the canal, or upon the crest of its banks, 20 feet to 30 feet high on either side. For the first time I was in a tow boat whose motive power was human, supplied by a dozen athletic natives, only too pleased to pull us up in four hour shifts at sixpence a man. The rate of travel down the canal was about 4 miles, and against the stream about 3 miles, an hour. At times we were glad to get out and walk for exercise, as well as to inspect special works. This gave me views between the tree plantations of stretches of open country, sometimes barren and desolate because no channels

reached them, or at other times busy and fertile, because the slope of the country permitted it to be watered from some small local source; not from the canal, which was for the most part considerably below the surface of the country, and had moreover drained the wells contiguous to it. In the lower part we passed one or two townships of the same type as existed before the advent of Europeans, their dull white and yellow buildings making one great mushroom mass of stuccoed brickwork within a high wall, which had low towers at points of vantage, and rising above them two or three domes from a mosque or saints' shrine. A line of peasants entering or leaving, a few goats and cows browsing upon stunted bushes in the sandy space about the village and a few crows flitting impishly from roof to wall furnished the only evidences that it was not the deserted habitation of some long since buried tribe.

The main canal ends just below Daroha, after a course of 39 miles, in a large regulating bridge, which divides the supply between the British and native branches in the proportion of 2 to 1. The native branch, 75 feet wide and 41 miles long, runs south-east, feeding three main channels and a navigation canal to Patiala, and passes three torrents under its course by means of large syphons, one of which consists of 9 barrels, of 25 feet span and 6 feet high, able to carry 13,000 cubic feet per second. The third channel, 30 feet wide and 25 miles in length, will hereafter be connected with the western Jumna canal, which is 50 miles further east. The native states here are thinly peopled, badly supplied with water, of brackish quality, 150 feet to 200 feet below the surface, and from wells 4 or 5 miles apart. An official report says that labourers are with difficulty induced to take contracts there, since "there is no shelter for themselves, or fodder for their goats and donkeys, the rainfall is scanty, the heat great, and every breeze is laden with blinding sand." It is not surprising, therefore, that under these circumstances even Hindu rulers were led to appreciate the advantages to be derived from perennial canals, and that it was the Maharajah of Patiala who in 1862 revived a project which had been first suggested in 1836 and 1840, and roughly outlined in 1856 by Colonel Dyas, the designer of the Bari Doab canal. An old Mahummedan canal had once for a season, supplied part of Patiala and the princely town of Sirhind, now in ruins. A project for its reconstruction was actually prepared, but owing to the disinclination of the British Government to see its waters utilised upon independent territory, and to the death of the enterprising Maharajah, was not proceeded with. Nevertheless an impulse had been given and information acquired.

It was decided in 1867 to prepare a scheme upon the best physical lines, ignoring political considerations. Colonel Gulliver accordingly submitted the first draft of the scheme as it stands in 1868, completing it in 1871, slightly amending it in 1874, and Colonel Hume finally supervising and finishing it in 1882. Three small states, Patiala, Nabha, and Jind, between them bore one third of the expenditure, as their branches water 2,948 square miles, against 5,528 square miles within British boundaries. They are entitled to re-

ceive 2,160 out of 6,000 cubic feet per second, and in 1889-90 actually received 1,811 cubic feet per second as their proportion. This was distributed by 2,200 miles of channels, so that 1,147 cubic feet were utilised in summer, and 1,358 cubic feet in winter, upon a total area of 152,000 acres, protecting crops valued at £400,000. Wheat and gram occupy the largest area, a long way after which come cotton and maize. Owing to native habits of administration the whole of the rates are not collected, and the duty of water is only one-half in summer and two-thirds in winter of what it is on the British branches. Of course, the whole cultivation is native on both, and these facts therefore indicate the practical value of European administration.

The British branch, 160 feet wide at Doraha, bifurcates 2 miles lower down, throwing one arm 100 miles southward, 84 feet wide at its head, and 24 feet wide at its tail, thickly studded with falls and bridges. North of this, and following a parallel line, is the Abohar branch, 88 feet wide at its commencement, but diminishing to the same size as its fellow at its termination, which lies 127 miles distant in a storage reservoir on the boarder of the Bikaner desert. There are 15 falls, 10 locks and 25 bridges upon this channel, from the 48th mile of which a navigation canal, 30 feet wide and 47 miles long, runs northward to the Satlej River. These branches for the first few miles pass through fertile country watered by wells 40 feet deep, but beyond this enter a dry tract intersected by sand hills, where water is from a 100 to 150 feet below the surface, and terminate in dry channels, where the annual rainfall is about 15 inches. Water is still obtainable even in the wilds of Bikaner beyond, though it is said that it lies at depths of several hundred feet, a fact which discounts very largely the extreme purity attributed to it.

The country watered is inhabited almost entirely by Jats, who are Sikhs by creed, and who are many of them landowners, though in one district a half, and in another two-thirds, of the farmers are tenants. Prior to the construction of the canal they obtained two crops a year on the average, but followed them by a year's fallow of the land on which they were cultivated, and by several ploughings whenever the rain softened it sufficiently to allow the burned stick to make any impression upon it. They manure a different part of the holdings to some extent every year. Those who occupy the driest tracts are immigrants from the sub-montane country, and have brought these practices with them. Throughout the whole area each village is a little organisation within itself, owning its wells jointly, and undertaking many necessary tasks in common. The Government have wisely taken advantage of the intelligence and discipline thus displayed by dealing with each of these little communities as an unit, to which the water is delivered, and which provides for its distribution and use according to its own rules. In the south the circumstances were formerly less favourable, and the Jats who settled there only obtained one crop in the twelve months, which was kharif or rabi just as the season permitted. Now they

obtain, like their fellows, two crops off part of their land each year. They are good agriculturists, all of them, though with the customary tendency to over irrigate and over crop which is common to all Hindus—and, unfortunately, to many Australians also. They have thriven often under adverse conditions. Under the hills the rainfall sometimes reaches 28 inches in the year, and the torrents in the rainy season run bank high, but beyond a belt of about 20 miles the showers and the floods alike fail, and are at best uncertain, becoming a diminishing quantity until they cease altogether to the southward in houseless, treeless, herbless, arid wastes of desert sand.

In the 2,500 miles of canals and distributaries below Doraha, the difficulties encountered are only such as are common to all irrigation enterprises. It was above that point that the task of a giant awaited those who were charged with the construction of the Sirhind. There was not only an enormous excavation to be made, for which there were no such supplies of labour as were available for the Ganges or even the Bari Doab canal, but for 11 miles it had to be carried through low-lying land, where the spring level of the water was 14 feet above the bed of the canal, and on whose spongy soil great masonry works had to be erected upon foundations of mud and sand. A railway of 54 miles was built, and worked by eight locomotives and 170 waggons for eight or nine years. Brick was used on the native branches for all works, but masonry was chiefly employed on the main line, and the stone had to be brought 14 miles to the nearest point of the canal from Nalagarh, where small quarries were opened. A four mile tramway was constructed 22 miles up the river to convey boulders to the rafts on which they were floated down. Timber had to be obtained at great cost from Patna and Calcutta, hundreds of miles distant, lime discovered and dug at Patarheri and *soorkhee*, or clean sand manufactured of bricks from the palaces and walls of the ancient city of Sirhind. The plan of excavating the upper portion of the canal by means of stationary engines and small waggons had to be abandoned and the plant laid aside. Heavy pumping had to be undertaken; firewood was scarce and dear. The bad quality of drinking water available and the inhospitable character of the climate, with its fierce heat and scorching winds, rendered it necessary to sink masonry wells and build residences for the staff with roofs tiled so as to resist the ravages of white ants. A large part of the digging had to be done in light sand, which was washed and blown back into the channel, and carried in such quantities by the summer gales that the railway track had to be dug out nearly every day in the hot season.

A few European contractors undertook small parts of the work, but the results were entirely unsatisfactory, and even materials could not as a rule be obtained by purchase. Such skilled labour as was required had to be imported, and there was a difficulty in obtaining anything like a sufficient supply of unskilled workpeople. Three gaols were established near the headwork, and

from these 1,400 to 1,800 men were always obtainable, who could be directed to any point of emergency. This contingent proved of great value, and materially assisted in the completion of the canal. During a famine in Sirsa 15,000 peasants were employed in digging and carrying earth, of which altogether 33,000,000 cubic yards were removed above Doraha. No conception of the nature of the task imposed upon those charged with the execution of this immense undertaking is possible, unless it is realised that it was carried out in a remote sparsely settled district, without important cities, where the officers were required to seek for their raw materials, or buy and test them, dig and burn their own lime, quarry and carry their own stone, find and grind their own soorkhee, make their own bricks and kilns, repair and partly design their own machinery, build and work their own railways, make all the surveys, supervise the construction down to minutest details, train their own carpenters, masons, and engineers, catching them first and watching them afterwards, while they gave shape to the great plan conceived on a colossal scale and practically executed in every part under the eyes and orders of those who conceived it.

Proceeding up the canal, which looks wider than the Murray at Wodonga or the Yarra at its mouth, we pass every four or five miles under bridges of sandstone, across which the traffic of the country side is quietly drifting. We meet now and then with large boats, which pay a small licence fee, partly covered in, well filled with native passengers, and with four to six rowers leisurely pulling. Our towing shifts change, but never flag during their spell, although one lover of tobacco carries his great hookah slung about him and takes his whiff from time to time. Our own attendants squat in the boat, having either the brazier or the hookah in the centre of the group, the latter being kept always going by a few live coals in an earthenware cup at the top. The pipe stand revolves on its axis without being moved as the mouthpiece is passed from one to the other of the circle, each, after a few deep, slow inhalations, passing the tube on to his neighbour. The smoke, retained as long as possible, curls slowly upward as it oozes from the nostrils of the passive recipient, whose half-shut eyes have an expression of stupified content. Opium, Bhang and other compounds are said to be occasionally mixed with the tobacco by those who can afford such luxuries, and we met one or two cases in which the habit appeared to have become thoroughly and dangerously engrained. The poorest Muhammadans make this their one luxury, and may be seen trudging by their donkeys mile after mile hugging the beloved but cumbrous hookah under the arm. At a few places I note a self-acting ferry, by which the natives are passing from side to side. A strong wire is stretched across the canal, carrying a small pulley, through which runs an endless rope, fastened to a boat. So soon as this is shifted to whichever is to be the forward end of the boat, the force of the current acting upon the skiff propels it, while the wire guides it across. The device delights the Hindus by its economy of their exertion, though they

are never quite certain that there is not witchcraft of some kind involved. As they learn to appreciate the beneficence of the Government they become more exacting in their demands, and are always profuse in their complaints, with or without reason. Once or twice groups upon the banks shout their grievances to us, with much volubility and much gesticulation to enforce their requests. When Mr. Reid lands he is at once surrounded by local officials and petitioners, who are listened to with a grave imperturbable coolness, comparable only to that of the Sphinx. If the Englishman does not beat the Hindu with his own weapons, duplicity, mendacity, and chicanery, he succeeds in baffling his subtle foe by his impenetrability and taciturnity; especially is he incomprehensible to his antagonist when moral considerations are taken into account, since the native usually places honesty last among all the contingencies upon which he calculates.

Every mile of the canal proves full of instruction as well as entertainment. Like a living organism, the great stream of water continually alters its environment, and is altered by it in time, so that the engineer's task is never over; he constantly meets new contingencies, and by the lessons of experience on his own or upon other canals learns to vary his expedients. The often repeated error in the slopes of channels has had its due influence on the Sirhind, which has nowhere been given an excess fall. The question of velocities, however, is being refined upon by many other considerations than that of a mere mathematical formula. It has been patent from the first that the fall given to a canal must depend upon the character of the material composing the bed; if it were cut in solid rock it might be anything you please up to the perpendicular; on shingle it might be 20 feet a mile, and on stiff clay, as in Ceylon, almost half as much without injury. In the soils of the eastern and northern Panjab, however, 1 foot in 8,000 has been found quite sufficient for safety for the new main canals, on branches a little less than 1 foot for every canal mile of 5,000 feet, and 1 in 3,000 to 1 in 4,000 on the distributaries, according to their dimensions. It is proved, however, that even with regularity of incline there is a notable difference in the velocity obtained upon various clays and sands.

To be absolutely right it would be necessary to adjust every strip of the canal to the particular class of soil in which it was excavated. This, of course, is impracticable. The velocity aimed at has been 2.4 feet per second at low level, 2.8 feet at mid level, and 3 feet at high level, but as a matter of fact these rates are usually exceeded, and in many parts the low level canal has a velocity of 2.9 per second and the mid level 3.2 per second, with a still greater maximum in flood time. The problem of losses is one still in course of study all over India, and their magnitude is patent almost everywhere. It is reckoned that on the Bari Doab 25 per cent. of the intake is lost in the first 53 miles, and on the Sirhind at least half as much upon its main channel. What the water is doing is judged not merely from calculation, but from trained observation

also. Velocity is roughly measured by the eye, and when little eddies appear it is known that silt displacement is going on below. At intervals we pass stations used for measuring the rate of discharge. Wires are stretched overhead across the stream, and floats are timed with a stop watch as they pass them so as to keep check upon the guages which stand at fixed intervals along the banks, but are liable to err owing to their silting up. The same practice obtains on the branches, so that by many and various methods every phase of the action of the running water is noted and tabulated day by day for investigation and comparison. Stores of invaluable information are thus acquired upon every canal, and although much of it owes its importance to the fact that it is local, there is material already to hand invaluable for purposes of generalisation to irrigation engineers in all parts of the world. The rare, occasional, or frequent experiences, which taken apart appear mere incidents, when classified become knowledge, and as they are more and more unified (to use the Spencerian formula), pass out of the region of ordinary observation, and being completely organised are entitled to the authority and dignity of science.

All this and much more does Mr. Reid chattily discuss, sitting at ease before our cabin, going up and down the canal, or else as we strike off to the further side of the plantation, putting up a partridge by the way, and stride along the native road beyond it. Mr. J. D. Derry, C.E., of Horsham, my companion in America, was an executive engineer upon this canal during its construction, and was honourably mentioned by the Government of India for services in that connection. An interesting report of his upon methods of excavation employed upon his section of the work was published in the Roorkhee series.

The railway from Delhi to Lahore was ballasted with bricks from the ruins of Sirhind, a circumstance which led to the revival of a prophecy said to have been uttered centuries since by a fakir, who cursed the city in its pride, and foretold that its remains would be scattered between those points. In the next edition of that prophecy the Brahmans may be relied upon to introduce some variation of the malediction, which shall also foretell their use upon the canal, and furnish another evidence of the faith for the confusion of local sceptics and the glorification of a new shrine.

The great achievements on the Sirhind can only be cursorily mentioned as they are met. Taking the works upon the main canal in their order, from the Doraha regulator, the first difficulty met with was from cross drainages, the lower of which the canal banks have sufficed to divert, while the upper, at Katlaur, Bassi, and Khiri, have been turned into three lakes that become almost dry at the end of autumn. They are connected with each other by cuts, and their overflow is led into the canal lower down. We next pass a series of minor drainages taken into the channel by masonry over-falls, which are doubled when there is more than 8 feet difference between the beds of the drain and of the canal, so as to avoid erosion. When cisterns are used on the branches, where the falls run from 8 feet

to 16 feet, and in one case to 24 feet in height, care has been taken to give them an upward slope of 1 in 4 on the down stream side, as the vertical walls used on the Bari Doab canal kept the rubbish carried into the cistern circling endlessly round and round within it, so as to wear away the floors. Passing a small syphon we reach the Chamkaur torrent dealt with on the same scale and in the same manner as on the Ganges canal. There are three sets of gates fixed in masonry piers, one in the canal, and one in each of its banks just above. When the torrent is dry, the channel regulator is open, and the canal runs between the closed gates of the torrent on the one side and of the escape on the other, which are closed like railway gates as a train passes. As the torrent rises, the canal regulator is closed and the side inlet and the escape opposite to it are opened so that the mountain flood rushes straight across the canal, along the face of its regulator, and out at the opposite side, as vehicles pass when railway gates are open.

These structures are very handsome. The canal regulator has a waterway of 200 feet (through 16 arches, two of them being 20 feet wide for boats, and fourteen about 11 feet wide), over which runs a handsome sandstone bridge, well finished and with five parapets. The slope of the country here is from south-east to north-west, so that the inlet is on the right looking up the canal. The escape to the left has been enlarged within the last few years in order to relieve the channel when necessary, even though the torrent may not be active. It has six spans of 10 feet each, with a bridge above, and is carried upon a 30 feet floor of masonry, having a 5 feet fall and being pitched for 50 feet beyond the floor, with long wing walls curved right back into its banks. The Satlej River, being only three miles distant, large bodies of water, unduly laden with silt, or that have been used for cleansing the canal, are discharged at this point. Their action has led to a great deal of cutting back in the bed of the escape which has required to be strengthened, if I recollect aright, by means of cribwork weirs. At this place wooden gates are used, raised by movable cranes, though at most works on this canal iron has been employed, because of the scarcity and expensiveness of good timber. A mile higher up we reach the Dohar torrent, passed underneath the canal by means of a syphon of four masonry arches capable of taking 5,000 cubic feet per second, or five-sixths as much as the canal itself. The Harun syphon and Kamalpur inlet, with many other works of size and importance, would deserve detailed description in any paper written for engineers. If the experiments tried and problems solved were added, a small volume could readily be filled with a full description of this great system, so multifarious are the works and so striking is the ability they display.

This part of the Sirhind canal cannot be understood unless its situation is clearly comprehended. Leaving the river by a great cutting from 30 to 46 feet in depth it plunges after the first three miles into the Khadir, or trough of the Satlej, a level marshy alluvial valley, built by the deposits of countless ages, through

whose soft material the mighty stream cuts its channel at pleasure, wandering indeterminately from one side to another, its waters still percolating freely through tracts which are at a distance from its present course. For 10 miles the canal had to be excavated in this spongy and saturated soil, upon which banks were heaped up 14 feet above its surface, while the canal bed sank at least an equal distance below the water level. The moisture rotted the woodwork, rusted the iron of the machinery engaged, occasioned endless repairs, and prevented the possibility of making a tram road on the soppy soil. Expensive cuttings were necessary to drain the springs in the first six miles, and the task of keeping these miles open proved by no means slight. Bunds and channels were necessary to protect neighbouring villages below. For the first two miles the excavated soil was run out in tip waggons to the river, and formed an excellent protection to the inlet, but afterwards the plant had to be abandoned. Famine labour poured in for three years, and the whole of the gigantic work beyond this point was accomplished by means of human hands. The stuff forming its miles of immense embankment was carried in little baskets out of its depths upon the heads of men and women. A powerful pumping plant was an essential all along this section, and in particular parts had much ado to cope with the constant influxes of water. The Donar syphon site was changed altogether, and even then its foundations required a system of pipe drains under them, while a large spring which burst through just outside it threatened the masonry until it was carried up to some height. Steam pumps were necessary on all important works, while the Chamkaur regulator and escape head were founded on blocks sunk 18 feet below bed level at great cost and loss of time.

The Siswan superpassage, however, proved most serious of all, for as its foundations were carried 6 feet below the bed, there was a head of 20 feet of water to contend against. It took two 12 inch centrifugal pumps running day and night for more than six months to get the water under, and then it took three with a mile of iron piping to keep the excavation dry. The earth was so rotten that it fell in at the side as the digging proceeded, thus necessitating a very much larger opening than was planned. The water-bearing strata were of unknown depth, and the seasons made no difference to the springs. Altogether there were 14 engines of 12-horse power each with 12 inch pumps engaged in this work, in which soakage had to be battled with at every step before the enormous task of excavation could be carried on. In the presence of this subtle, untiring, omnipresent enemy there was no rest for the engineers during the first years of their anxious enterprise.

Four miles above the Dohar syphon we reach this superpassage, by means of which the waters of the Siswan are carried over the canal. Walking along the towing path one obtains some idea of the proportions of this piece of masonry, providing an overhead waterway for a Himalayan torrent of a width beside which the bridges of London and Paris are insignificant. The solidity of the piers might lead one to suppose that icebergs were expected here as upon

the St. Lawrence, but as a matter of fact it is the weight of the enormous flood of water which has to be sustained that renders them so formidable. There are seven spans of 37½ feet waterway in each, beneath which it takes us a long time to pass, for the bridge is 250 feet between its parapets. and 320 feet long, thus almost equalling the largest superpassage upon the Ganges canal. It supplies a crossing place for 24,000 cubic feet of water per second. This torrent occasionally swirls down upon it twice and a half as wide as Bourke Street, 10 feet deep. and with waves 4 feet high. It plunges from the hills with terrible velocity. notwithstanding that works for its control commence 2 miles up stream and are continued 3½ miles down stream. Taken as a whole, and having regard to the immense difficulties encountered in finding foundations, it must be considered a cheap work for £90,000. This is only three-fourths of the cost of Princes Bridge, with its rock blasting and its embankments, although the superpassage, built upon mud, is nearly as wide as our bridge is long, and more than twice as long as the bridge is wide.

After this we walk along the high bank in order to take a look at the Khadir through which the canal is cut. Close to us a little sugar cane aud maize are grown, and there are patches of cultivation further off, with mound-like marsh villages on far off ridges, but for the most part it appears to be a uo man's land, on which there is some grazing, but where the soakage below and the sandy surface above combine to limit production. The Sirhind is so emphatically modern that the laud it occupies was all purchased, and at rather high rates, reaching on some districts 10s. or 12s. au acre. but falling in others, and iu the native States especially, to about half that sum. The amount paid for land altogether exceeded £120.000. Far below the bank crest lies a sodden reedy strip of worthlessness belonging to the canal, upon which the undaunted ingenuity of the engineers has been brought to play. A cut is made from the canal. and the land below is embauked and checked so that water admitted finds its way slowly along it and finally into the canal again, or else into a natural drainage channel. Whenever the water is silt laden it is allowed to run into these receptacles until it settles. when the clear stream is drained off. The fertilising material is allowed to remain.

This process, known as colmatage on the banks of the Rhone, where it has covered beds of shingle with first class farming soil and fine pasture, here builds up narrow fields of exceptional richness and fertility, capable of growing heavy crops annually, and at the same time serving as valuable buttresses and protections to the canal, even assisting to reduce its percolation in the long stretch of 4 miles, in which the banks are 14 feet above the surface of the Khadir. Seven feet of silt has been deposited over one of these plots in five years, and it is calculated that by a running foot of water 500 cubic feet can be deposited in the year. The process is termed warping, and is conducted with much judgment. Floods, for instance, that are greyish in hue are as far as possible excluded

from the canal altogether, as they are thick with undesirable silt, while those of a reddish tint are admitted, because the material carried is light and fertilising to the ryot's fields, and to the warps of the canal officers. The greatness of the scale upon which the engineers work does not prevent them from studying small economies and increments. The rents of reclaimed plots are gladly added to the receipts from plantations which already beautify each bank. The Arabian acacia, the rosewood, and the pipul, flourish all along the banks of the Sirhind, affording a grateful shade in summer, solidifying the canal, beautifying it, and increasing its revenue all the year round. Here, as on the Bari Doab, the eucalyptus is found and welcomed. Executive engineers delight in nothing so much as in adding to the botanical wealth of their divisions, and acquiring groves such as those through which for the last part of our journey we drive very pleasantly in a little English dog cart.

The crowning glory of the Sirhind, and indeed of all the canals of India, in point of size, is the Budki superpassage, at which for the time we leave our boat. Two great torrents, the Sugh and Budki, send down at times 30,000 cubic feet a second, or rather more than the minimum discharge of the Nile, straight at the canal. Originally they attacked it with divided forces, but the art of the engineer has led the Sugh into the Budki, so as to deal with them both together, receive their waters in one volume, lift them over the canal and despatch them into the river a little way below. The bridge by which this is done is 400 feet wide, with parapets fourteen feet high, between which there accumulated on the last flood thousands of tons of sand, on which we walk from one side to the other. There is little to tell of the torrent bed above, its banks being ill defined and the expanse so great and varied in its conformation. The ravages of the floods are concealed by the mass of *débris* which they leave behind them. As we see it, a piece of the Sahara, Mapimi, or Maricopa deserts could not be drier or barer, yet in the rainy season it is covered with a tide which thunders down nine feet deep over a bridge as wide as Flinders, Collins, Bourke and Lonsdale streets put together. This mass of masonry may be compared even with the colossal works of antiquity outside Egypt, the only country which possesses a wider canal. There are seven arches of 31.75 feet each, of sixty degrees, rising ten feet above ordinary water level, resting upon piers eight feet thick, supported by a three feet concrete slab under the whole edifice, and five feet thick, under the piers, with curtain walls eight feet deep both up and down stream. The bridge rests upon clay, as did that for the Siswan, which had water bearing sand below clay for fifty feet (as far as was sounded), and the concrete slab under which stretched twenty five feet up and down stream beyond the cut-waters, with curtain walls eight feet deep as a termination. The Budki superpassage cost £125,000 in India. It would be hard to estimate its contract price in Australia. It has stood the strain to which it has been subjected admirably, but in consequence of some fresh calculations of Mr. Reid's its parapets are to be strengthened

Were it to fail it would wreck the canal for miles, and do untold damage to the country beyond it. It seems impossible that it should fail, but when it is remembered that tens of thousands of tons of water are hurled across it suddenly at a high velocity, it appears surprising that any structure reared by human hands can be capable of sustaining the onset.

Our first journey ends when crossing the canal by a seven-span masonry bridge, 332 feet in length, we drive through Rupar, one of those walled frontier towns that in times past has enjoyed a stormy history, but which to-day, scarcely visited except by an occasional canal or revenue officer, lives its quiet life in its own way, exhibiting a truly oriental indifference to events beyond its bounds, or to any small improvements within them unless they afford an immediate pecuniary return.

After a night's rest in the Bungalow we are out early to the headwork partly seen the evening before. The bed of the Satlej here has about the same width as the Ravi at Madhopur, but carries a much larger water supply. The banks are not nearly so high, that near Rupar being chiefly built up by the spoil from the adjoining cutting, and now handsomely planted with trees. The Siwalik hills, through which the river has taken its way, do not closely approach the Rupar side, and opposite it do not attain a greater height than 300 or 400 feet, while the masses of the Himalayas from which they run lie in the far distance. A couple of hundred yards up from the main mouth of the canal is the masonry lock and channel by which boats from the Satlej enter the Sirhind. The inlet, itself at right angles to the river, has 13 arches of 17 feet each, containing 39 strong 5 feet wooden gates. Its sill is 2 feet higher than that of the outlet, which has 12 openings of 20 feet each, with three tiers of iron gates 2 feet 6 inches, 5 feet, and 8 feet respectively. It is built of masonry, upon strong piers, like those at Madhopur, capable of resisting floods, with their floating armament of trees and boulders, and makes a fine bridge, upon which lately a powerful movable crane has been placed. The foundations for both inlet and outlet are in mud and sand, so that the first rests upon a floor stretching 15 feet outward and 40 feet along its course, while that of the outlet absorbed 160,000 cubic feet of masonry and 32,000 cubic feet of concrete. The regulator is on the same model as those employed on the Ganges and Bari Doab canals, comparing favourably in size and strength with any in India. On the outer edge is a series of steps forming a ladder, by means of which fish are enabled to pass the fall when ascending the river.

Beyond the outlet, at an angle of 15 degrees, extends the weir, one of the most substantial in the country, because of the strain to which it is subjected. The figures supplied to me on the spot vary a little from those shown on the official plans owing to alterations made during the execution and since. Two walls of masonry, the one 16 feet deep and 7 feet wide, the other (30 feet behind it) 12 feet deep and 5 feet wide, are carried right across the river, 3,400 feet from the outlet to the farther shore where they terminate in a

flank wall with revetments, supported both up and down stream by masonry spurs. The space between the two walls is filled with dry rubble, and the same material is packed behind the second wall for about 50 feet, on an incline of 1 in 15. On the whole of this is laid a masonry skin 3 feet thick from wall to wall. Its first 10 feet of crest is level, it then slopes to and across the second wall, after which it is two feet thick and is further prolonged by a dry floor of boulders 4 feet deep and 20 feet in length. In front of the first wall rubble is packed with a slope of 1 in 3 for 24 feet up stream, and this is then carried 10 feet further as a level floor 4 feet in depth. The whole great backbone of masonry and boulders forms a solid reef of 200 feet thick from front to rear, carrying falling gates of iron 6 feet by 6 feet, divided into two parts, one 3 feet 6 inches and the other 2 feet 6 inches in height. For the greater part of its length the weir is built on shingle, and seems strong enough to defy everything until the day of judgment. But it is not so. The last high river has tumbled over it with such whirlpool ferocity as to tear a great piece of masonry 150 feet long and 100 feet wide out of the toe of the weir. Shot and shell could not have accomplished the work of destruction as thoroughly as the water as done—lifting and splitting the enormous layer of boulders, and distributing it in fragments scores of miles down stream. The damage was being repaired at the time of my visit by a row of eleven hollow squares, 12 feet by 12 feet and 10 feet high, masonry boxes without top or bottom, 2 feet thick in the sides, which are filled with cement and then sunk. These form a line of great blocks which, when furnished with a masonry setting, it will task even the Sutlej to extract and toss away. Unless one were an eye-witness of the ravages which a river is capable of making, it would seem incredible that it should accomplish feats such as these, seeming to display remarkable skill as well as almost incalcuable strength. So surely is the weak point of every work sought for and found, so entirely unexpected is the form and mode of attack, so sudden the onset, and so subtle the direction of the mighty forces, that one might almost credit the native stories which endow it with a demon intelligence.

The walk across the weir occupies some time because of the leakages from the iron gates which are holding up the stream, now at its lowest, and because of the lines of Changras, who are busy in the work of repair, burrowing like beavers as they extract the injured boulders, and filing away without distinction of sex, basket on head, like columns of busy ants, removing sludge and shingle. They work ten hours for the sum of 4½d., at this kind of task, though some skilled labourers permanently employed receive as much as £2 or even £3 a month. The latter rates are high compared with those which they obtain at ordinary vocations, and afford them opportunities which they often seize of taking a holiday for a week or ten days, in order visit their friends or celebrate a festival. The best pattern men in the engineering sheds earn as much as 1s. 3d. per day, while fitters, moulders, and engineers, of deftness and ex-

perience are sometimes paid 2s. a day. The average is, however, lower than this. Those who are in receipt of such wages are certainly no less ready to find excuses for absence than their unskilled associates, and the consequence is, so the foreman tells me, that he is compelled to give much of his work to them by the piece, practically arranging small contracts which the Hindus prefer, as permitting them more freedom.

None of these people appear to be sufficiently civilised to sacrifice their lives for the purpose of obtaining the means to live, or to squander their health and comfort in order to acquire property which they will be unable to use or enjoy. They are barbarous enough only to work so long as it seems wise, and to insist upon having their share of rest and recreation as they go. To work for the sake of work, day after day, without regard to current spectacles and amusements, family gatherings, or public celebrations, seems a foolishness to the natives which none of the missionaries so far have been able to persuade them is necessary to salvation. Hence so far as appearance goes they are a good deal happier and more light hearted than the anxious-browed white engineers, who stride here, there, and everywhere, strenuous and ardent, amidst the cheerful indifference and unconcern of the Hindus. In Asia, as in the South Sea Islands, the indomitable Briton is an object of surprise and pity rather than of admiration, because of the untiring energy, sleepless zeal, and indefatigable persistence which he displays in trying to do to-day what might just as well be done to-morrow, and, so far as the Changra cares, might never be done at all. A pious ignoring of the consequences to follow from inaction renders the natives somewhat uncomfortably suspicious of the religious sincerity of the Englishman, who appears to regard the future with unmitigated distrust, displays a total want of confidence in the beneficence or justice of nature generally, and the river especially, leaving nothing to Providence except what he cannot control himself.

A great deal is taken out of the realm of chance by means of this gigantic scheme which directs a perennial stream of from 3,000 to 6,000 cubic feet per second upon 640,000 acres, and is capable without further outlay, of watering 140,000 acres more. The total expenditure upon it to date is £4,700,000, a larger sum of public money than is likely to be devoted to irrigation in Victoria—or indeed, in Australia—for many years to come. Of this sum £3,700,000 appears in the accounts of the British branches, which, although they have only been in full working since 1886, and have the serious disadvantage of traversing a poor and thinly peopled territory, steadily increase their returns year by year. At present they yield 3 per cent., and are shortly expected to pay full interest and a profit to boot. This being the result of the greatest and most expensive single scheme in India, it does not appear as if any irrigation enterprise need be questioned on the score of scale. Works such as these represent the sinking of millions of capital in the country, and therefore imply a certain risk in war; but they

also offer the highest and best security for the lives and loyalty of the tens of thousands whom they maintain and of the armies they can feed.

Temple Point is the name given to the spire-like peak from which we look down upon the headworks of the Sirhind, laid out before us as if in a model. The river curves down two main channels, one close to each bank, around a low island of sand in the centre, the larger of them encountered by the projecting promontory of made ground, its face pitched with boulders, in which the lock and inlet lie. Behind them are the plantations, and a little lower the large workshops, fitted with fine machinery, and employing 120 men upon work for the canal. This plunges into the hills by a gash under the walls of the town of Rupar, whose battlements and buildings crowd against the hill to the right. Up the channel, rowed by a native crew, comes the spacious yawl which is to carry us down to our tow boat sent on ahead. The river bed, broad and bare, is being cultivated here and there by Jats, eager to secure a crop from the fertile patches which are to be found among its shingles. The stream, blue and bright, shining like an unsheathed scimitar, runs past their plots by glistening banks of wet sand, whose hues, ranging from ochre to russet, are enriched under the declining sun with gleams that change as does the iris on the neck of a dove. They melt without perceptible division from salmon pink into lilac, to saffron, and French grey. Delicate and aerial in their beauty, they become more so by contrast with the cliffy shore. This is composed of soft rock and clayey sand of many terra cotta tints, cut into the wildest and weirdest shapes by bewildered torrents flying in blind haste from the heights above to the river bed below.

The old goldfields in the Bendigo district, where the white pipeclay has been stained with coarse yellows and dull reds, among wastes of abandoned shafts and mullock heaps, before the young gums have had time to drape them afresh, or the enterprising vigneron to plant them with dotted rows of graceful vines, furnish the only possible likeness to the Siwaliks where they border upon the river. Nature at times, can, it appears, become as ruthless as the Vandal man, and as reckless in her passion. Here, as in the last stretch near the summit of Vesuvius, where, however, the sublime prospect modifies the disfigurement of the face of the earth, or as in the deserts of Nevada or the Yellowstone, where the action of the elements has shaped the many-hued clays into grotesque and awful semblances, it appears as if malevolence and malice had wreaked themselves pitilessly upon a patch of the wild. One might believe that the flaming thunderbolts of offended deities had been expended upon an unhallowed site; so bare of verdure, so bereft of shelter, so distorted and blighted are the ravines which lie about us. A few villagers follow a narrow trail across the desolate summits, and descend slowly into defiles where nothing springs but thorny bushes of the wait-a-bit type, their branches studded with penetrating barbs—not a bird, not a tree, not a leaf, not a curl of smoke

breaks the monotony, or betrays the presence of life, although one beholds miles of sterility, spread away, blank, gasping, gaunt, and withered, to where purple mists enshroud the snowfields and majestic peaks of the Himalayas.

Out of those far off mountains and by this thirsty spectre land come the thin streams of water which are now filtered into the canal, to carry its boon of harvests for scores of miles into country almost as unprofitable as this. But in a few months there will be no longer this empty valley, and this quietness of air through which the voices of the Changras on the weir make a faint murmur. That great reef will then be hid in foam, when the flood tide, spreading from bank to bank, and hoarsely roaring, will sweep down 12 feet to 16 feet deep, half a mile wide, shifting its quicksands and shingle beds from side to side as a porter shifts his load, tossing its tangle of trees, grinding its ranks of boulders against the stubborn mass of stone and iron that will bar its way. In that season of over-abundance, as in the season of drought, the works will fulfil their duty to the far off thirsty plains, and the busy thousands, who wait with confidence under the blazing sun for the trickle in each tiny channel that brings life and fruitfulness to their perishing fields of grain. In the heat and in the storm the engineers will stand to their posts, and flinch from no contest with flood, fever, or famine, or with the river which they master (as their Government masters this people), to prevent the ruin which must certainly follow if its great subject forces should ever master them.

CHAPTER XIX.

INDIAN IRRIGATION.

Having now glanced at the chief typical works of Indian irrigation we can perhaps afford to remit to appendices the fuller account of the many and various schemes in the several Presidencies, of present magnitude, and future prospects, and proceed at once to sum up, in a cursory way, the results of Indian professional experience, and the duties of Indian irrigation engineers. Nowadays, before any scheme is sanctioned, the country is carefully levelled with cross sections close together, so as to admit of the utmost accuracy in estimates, and also to ensure the choice of the highest land for the main canal, the branches and the distributaries, all of which are carried as far as possible along the ridges of the country, to which the alignment is adapted as closely as possible. So strongly is this insisted upon that £40,000 is being spent in the Panjab in altering the lines of channels adopted only a few years since. Every effort is made to study what may be termed the habits of a river, and to adapt works to them as far as possible instead of endeavouring to force it into a preconceived plan. The weir across the Satlej, for instance, was built bit by bit, in order that the changes in the river which resulted might be examined, and taken advantage of where-ever opportunity offered. The ideal of Indian engineers for perennial river canals is the establishment for headworks at the highest possible level, with an outlet immediately adjoining the inlet, and some feet lower, so as to obtain a powerful scour across the face of the inlet. Another escape a few miles down with a second regulator is a desideratum, so that the entrance of the canal can be readily and cheaply cleared.

Below this the aim is to maintain the high level as long as possible, disposing of the surplus fall by vertical drops into masonry cisterns, opposing a cushion ten feet or twelve feet deep to the current, and with an upward slope from them along the canal. Rapids would only be employed in quicksands, and when boulders were to hand. Side drainages have to be dealt with by means of syphons, superpassages, crossings, or aqueducts, as the case may require, while the smaller are taken into the canal, which then of course demands extra escapes below. An even fall of one foot in 8,000 is preferred, but this is varied in some degree, according to the bed soil, the velocity over gravel and clay being safely four feet a second, while over loam three

feet is the maximum, and over sand much less than that. Where the canal has to be carried with its bed above the level of the country, a masonry core wall would be inserted in each bank. Puddle walls are not in much favour, as it is thought that the whole of a dam ought to be a puddle wall. No irrigation is permitted from the canal itself, from which all outlets ought to be of masonry. The branches are given a greater fall, of about one in 5,000, and the aim, is, if possible, to get the channel five feet deep, two feet below the surface of the land and three feet above it. The outlets upon it are also masonry, and a few escapes are provided.

The silt berme which forms on the side of the stream is regularly cut, and the deposit annually removed. Weeds are destroyed by means of silty water, if the fall is too slight for the current to keep them down, but they rarely flourish in a stream over two feet a second in velocity. On the distributaries the fall is again increased to one in 3,000, or one in 4,000, with a rapid incline at the tail into a natural watercourse or river bed if possible. A great dislike is manifested to dealing with water in dribbles, even in the distributaries, and a "full head" is always sought for. When a branch does not convey a sufficient quantity to fill all the distributaries full, what is called "tateeling" is introduced, which means that the flow is concentrated upon one or more of them so as to allow of a good stream being discharged into the village channels, and thus the branches are filled in their order. One object of this is to avoid the percolation, which tends to increase relatively with a small supply. Large losses from soakage are admitted on all the Indian canals, though as yet the returns are not complete enough to enable the matter to be thoroughly investigated. From one-fourth to one-third of the intake is often missed in the main canal, and sometimes twenty per cent. to thirty per cent. in the distributaries, so that it is safe to say that fifty per cent. of the intake disappears before it gets into the village channels, or at all events upon the fields.

An Indian engineer lives for half of the year at least in camp, or along his canals, while the executive staff, except for brief holiday intervals, never leave them. The chief officer of a Presidency, making a periodical tour of his district in the cool weather, is no small personage, and maintains his rank by a fitting equipage. When Colonel Ottley leaves Lahore for the inundation cuts on the Indus, he marches with a train of 70 camels, and horses in great number. The camp, like a little settlement, with its street of white tents, well furnished for all purposes, one for office work, another for eating, a third for sleeping, and a fourth for the reception of distinguished visitors, as well as those of the assistant engineers, sub-officers, native overseers, servants and under servants of all classes, is struck after breakfast and disappears on camels in the distance—a long line of huge humps upon many legs. The day's inspection follows its route, and the staff meet again towards evening to find the same camp ready pitched in another spot, fires lighted, and meals set, the whole transferred as if by magic to the same position and to the same order as in the morning, even the little

articles or papers being found lying, as left, on the same spot, in the same tent. The picnic character of these expeditions is the brightest spot in the year's duties.

There are many respects in which the successful officer requires more than strictly professional qualifications to attain his end, particularly when brought into direct contact with the ryots as contributories to a scheme. When for instance *dak* labour is employed, as described by Colonel Grey, the whole village requires to be marched out *en masse*, with drums beating, in order to give the people spirit and ensure their presence on the work. Grey beards look on and cheer the labourers, young lads and girls carry baskets of earth, some women cook, others bear burdens, while the children get in everybodies' way. Fruit and cheap refreshments are distributed. When a breach has to be stopped the whole strength of the party is put forth. They are divided into bodies with distinct lines of march, everything is prepared ready to hand; poles are poised, gabions loaded, brushwood stacked in piles, mats stretched and bags of sand ranged in order, until at the signal the whole swarm pounce upon them and carry them down in a sudden silence, broken only by the order of command and the fitful beating of drums. Poles are thrust deep in the bed, gabions tipped over against them, brushwood flung across, mats spread, bags of sand tossed upon them, baskets of earth quickly follow, until, amid the frenzied thrashing of drums, the whole crowd precipitating itself upon the spot, the bund rises and is strengthened until it stands the full strain of the stream, amid exultant shouts of applause and improvised dances of triumph. In the evening there are a few fireworks, a little feasting and a few presents, and then the community drifts off under the starlight, proud of its achievement, indifferent to its sacrifice of time and labour for a common good, and on excellent terms with the engineer *sahib* who has diplomatically secured this contribution towards his season's plan. To distribute such tasks fairly, and to secure their prompt performance by a series of scattered villages, is no easy matter. Organisations of this rude kind are rarely required in connection with major schemes, or those of which the Government is proprietor, but duties of the same nature do devolve more or less upon all executive officers in all systems.

To devise, amend, and supervise a great irrigation scheme involves gigantic responsibilities. The greater canals are marked off into divisions, in each of which is placed an executive engineer, with one or two resident European assistants and a staff of natives. The smallest division on the Sirhind embraces the headworks, 1,000 miles of channel, and 250,000 irrigated acres. The ruler of such a territory is more powerful than a Rajah, and has far more important duties. The head of a circle embracing one or more schemes is like the commander in chief of an army, who controls the campaign as a whole, but the executive engineers are the generals in independent command, upon whose individual initiation and capacity the fate of each battle usually depends. Their great antagonist is the river, whom they are obliged to treat as the Viceroy does many

of the semi-independent races on the borders; equally fickle, equally blind in their fury, whom he is bound at the same time to subdue and use. It is even advisable to permit a certain freedom of movement and accept a certain risk, preparing for the periodic risings which are certain to come. With such a foe, strife is merely suspended and never concluded, though the time, place, or manner of the intermittent outbreaks can never be quite foreseen. The customary relation between the two is one of armed truce.

Ordinarily the river is employed as an agent of peaceful husbandry, but a sleepless watch is maintained on its movements, and the least change is at once made known, while the engineer is always on the *qui vive* and ready for the inevitable war at any moment. All canals are supplied with wires and telegraph stations, which are in constant use, for the river is never the same for more than a few hours, and the reception of its variable gifts has to be exactly regulated according to the variable draws on the distributaries at the other extremity of the scheme. Even in ordinary seasons the engineer has no light task, for his first telegram reaches him at six o'clock in the morning, and during the day 20 gauge cards and 15 more telegrams have to be read, tabulated and studied, so as to keep his balance of water neither too high nor too low for the wants of the thousands of ryots, whose requests for a supply follow the changes of the clouds or their caprices, and cease altogether, or come pouring in all at once. When, however, the gauges vary by the tenth of a foot in the hour, the engineer abandons his rest, and all night the tick tick of the telegraph key is heard in his office, as reports rush in and orders are sent out in rapid succession.

The enemy is subtle and treacherous, and if there is a weak spot in the defences may be surely trusted to find it. Other branches of engineering admit of some latitude, and even of errors, without disaster. Thus a mistake of 10 feet in 100 miles of railway levels was recently detected in Bengal, though no injury had resulted from the blunder. With water the mistake would at least have been registered with the utmost nicety to the fraction of an inch the first day the canal was opened. If there be a spot in an embankment which has been scamped or neglected, water will infallibly discover and take advantage of it. When rain begins the canal supply is at once brought in hand, and for every inch registered the intake is dropped so as to lower the intake a little more than an inch. The closing and opening both require to be very gradual, and, not as the uninitiated might suppose, rendered as simple as turning on or off a tap in a bathroom. If the supply were suddenly shut out, the berm or side crust of silt along all the banks, and probably the little tow-paths just above it, would all fall in for miles, and occasion immense damage. Something like this was experienced on the Goulburn when the river was first banked up by the weir. Three inches an hour is the quickest fall allowed to the Sirhind, until it comes down to two feet in depth, when it can be closed at once. The admission must be governed just as cautiously.

and hence the need of looking ahead and interpreting aright the slightest variations in the stream. The Ravi River, with its fall of 27 feet a mile, might be almost dry at evening, and a raging torrent feet deep and hundreds of yards wide before midnight.

Unceasing vigilance is maintained, therefore, night and day far up in the hills, where the thunderstorm is breaking, and far away on the thirsty plain, where the ryots, who have been clamouring for a full supply, suddenly drop all demands at sight of the coming shower. All the burden of their harvests, and sometimes of their lives, rests upon the shoulders of the executive engineer, who must have been wise in his design, keen in its inspection during construction, far seeing in his provision for the crisis, and calm and collected when it comes. When the storm has burst and the river is up in its wrath, charging upon the works, fresh torrents leaping down from the mountains to the encounter, the country under water, and the panic-stricken people flying for shelter to the high ground, the engineer must stand his ground, see that all gates are closed and all escapes open, and that gangs of men are ready to hand with crates, and timber, and branches at any threatened point. He has an enemy to resist, fiercer, bolder, and more relentless than any human antagonist—the sullen and leaden skies pouring down their thousands of tons of water; the earth riven before it, giving it free passage to the spot where the structure reared by human ingenuity seeks to withstand its wild and desperate charge.

In northern India the engineer is a ruler of men; to him are directed the manifold complaints of irrigators, and the appeals in village disputes; into his hand pour complaints against his subordinates, reports of his officials on petty contractors and labourers, and the thousand and one pleas by which all alike seek to make the State their prey. "The great secret in canal, as indeed in Indian administration," says an Irrigation Manual, "is personal government. With Government officers sympathising and in contact with the people, while at the same time resolved on seeing justice done to the Government which employs them, almost any system can be worked successfully." Another paper issued to officers lays it down that the hearty co-operation of the leading natives is first to be secured, and next, that "till subordinates are trained it is absolutely necessary that the officer should see to everything himself. . . . Till experience is acquired, he must . . . select the lines, give the designs on the surveys, check the calculations, lay out the work, arrange its distribution, supervise its performance. . . Gradually the task will become lighter, but throughout the secret of success is in the master's eye." This, it will be confessed, is in itself no light obligation, and this is but a part of a great whole.

Out of this endless tangle of complications, dealing with many castes and races, each in its own way, and doing rough and ready justice as he goes among his subject people, most of them willing to corrupt or be corrupted, the engineer emerges into another atmosphere, in which it is necessary for him to address himself to the task of obtaining the sanction of his superiors at a distance to the

repairs and reforms he desires, while explaining to their satisfaction every hitch or change in his domain. The excellence of the administration upon these canals is as marvellous as government in general is marvellous in India, so cumbrous does the machinery appear, so foreign to the people for whom it is kept in motion, and so burdensome to those charged with its control. And then the professional tasks of the engineer are never over. To repeat a simile employed before, a canal is a living thing, which is always changing, or becoming liable to change, and upon which invisible alterations accumulate until they become visible in a catastrophe. Checking and rechecking of intake, output, silting, flow, loss, drainage, and velocity, proceed day after day, and month after month, with calculation and re-calculation of the strain upon works, and methods of meeting them, as new conditions arise.

Add to this the diplomatic dealing with native notabilities, and perhaps independent princes, villages crammed with ignorant peasants, townships plentifully endowed with fiery fanatics, a host of more or less unreliable native auxiliaries, and thousands of helpless ryots who dare not complain of some of their most serious wrongs from his subordinates. Superimpose upon all these duties those belonging to departments desiring information and assistance, or contending against the canals on behalf of their clients, and one forms some idea of the responsibilities resting upon the shoulders of Indian officialdom, and especially of the men in charge of canals and their divisions. Seeing their high character and great ability, recognising their physical trials when in the weary, wasting, feverish, autumn heats, the demands upon them culminate—the safety of the summer crops requiring them to be abroad daily, at a time of year when all the heads of the service have fled for relief to the coolness of the hills—it is not too much to say that, after all, the finest product of irrigation in India has been, and is, the gallant company of its engineers. Enormous responsibilities are theirs, and they have discharged them, with as much courage, and as much success, as their brethren who have stormed the hill forts, or faced the tremendous odds of battle, planting the standard upon a territory which even then was but half won, seeing that it had next to be maintained by an endless struggle, no less severe, for fertility and against drought.

It cannot be said that even upon the spot the services of the engineers have been duly recognised by those entrusted with the control of the administration. Farsighted Viceroys have adopted a bold policy of expenditure upon irrigation works, and thoughtful members of other branches of the service have at times expressed their admiration for the ability which has made them a success, but the men themselves have rarely been rewarded as they deserved, either in view of the importance of their charge or of its arduous conditions, even when measured against the always exhausting work of other officials in the same outlying districts.

The Water Supply Department, as a whole, is a bureaucratic service which, though not free from faults, has an honourable re-

cord, and will certainly compare favourably in energy or ability with any other Department in India. It adds greatly to the ease of administration, though it multiplies its perils, that the clients affected belong to a subject race, and that the vernacular journals do not appear to have yet developed that critical faculty which makes the press in Anglo-Saxon communities occasionally a means of mischief, but on the whole a most efficient and invaluable spur to administrative lethargy and favouritism. The public spirit, incorruptible integrity, and tenderness to the natives exhibited by most officers is highly creditable to them and to their country. So far as can be judged by a passing stranger they do their work admirably, and, considering all the circumstances of the case, inexpensively also. The irrigation branch, like every other, has been always subordinated to considerations of State, was originally entirely in the hands of military men, and still retains a great number of officials who bear military titles, though during their whole careers they have been engaged on civil service. The Royal Engineers have found the water supply offices happy hunting grounds in which their term was counted for promotion, where they enjoyed as a rule increased emoluments, and could take up their martial duties if at any time inclination or prospects of advantage prompted them. This system worked well for them, and perhaps well for the country, as it allowed the retention on the spot of able men, available for active warfare at any sudden emergency. The distinguished part played at the siege of Delhi by Colonel Baird Smith adds an additional laurel to the crown which he won by his literary and professional successes in connection with irrigation.

The civil staff, however, complained, and not unnaturally, that the prizes of the Department were all reserved for soldiers, while the harder work and lower pay of subordinate positions were left to them. For years their protests were disregarded, but gradually their position has been bettered, and quite recently a new set of regulations has been prepared which will tend to equalise their chances, and secure them a fair reward for their labour. As a matter of fact this appears to be chiefly due to the growing complexity and importance of the work of irrigation engineers. In the early days canal excavation was regarded as an ordinary piece of work, to which any professional men might be detailed with confidence, and many of the costly blunders committed were due to this ignorance, and to the want of training possessed by military engineers. Here, as elsewhere, the specialisation of functions has proceeded; and the need for practical experience of a particular kind, in addition to special ability, has been recognised at headquarters. Madras and Bombay to-day have civil chiefs, and the Panjab a strong body of eminent civil officers under Colonel Ottley. The North-West Provinces and Bengal are still under military direction, but in the former of these the civil element is growing. There is no doubt that the subordination of irrigation to military necessities has been a cause of loss to the Department, but it has given on the other hand so many men of conspicuous ability to the service that

it would be ungrateful to press the complaint. It has been necessary to build up the Empire of India, as Jerusalem was rebuilt in the time of Ezra, sword in one hand and trowel in the other. To the men of the sword rightly belongs a chief share of the honour, even of its pacific achievements.

The Government expenditure may be viewed in several ways. Thus, regarding works which are almost wholly new, the figures would run:—

	Expenditure. £	Acres irrigated annually.
Ajmere	160,000 ...	35,000
Bombay	2,500,000 ...	85,900
Sind	1,180,000 ...	150,000
Bengal	6,000,000 ...	550,000
North-West Provinces ...	8,000,000 ...	2,000,000
Madras	5,300,000 ...	2,400,000
Panjab	6,500,000 ...	3,000,000

The fact that native works have been more largely utilised in Madras than elsewhere partly explains the relative cheapness of its schemes. Roughly it may be concluded that British canals have cost £4 per acre irrigated, and they pay $3\frac{3}{4}$ per cent. on the outlay. Adding native canals, absorbed in Government schemes, the table would be increased by—Burmah, 200,000 acres; Sind, an extra 1,000,000 acres; and Madras another 2,600,000 acres, making about 13,000,000 acres for £33,000,000, yielding 4 per cent. net revenue. In the course of a few years the totals will have risen to about £35,000,000 outlay for 15,000,000 acres watered, reckoning twice-cropped land twice, so that in reality the actual surface cultivated is considerably less. To this total has to be added the immense extent of country everywhere, but especially in the North-West Provinces and in Madras, supplied from wells and tanks by the Hindus themselves, and also the totals of the independent states, including Government and private schemes. There is no absolutely trustworthy record of these, but it is safe to say that they more than double the land irrigated from the canals of the British Government. There are, therefore, over 30,000,000 acres watered every year within the Empire, with a constant tendency to increase the area. Nowadays this increase is limited by the fact that almost all the accessible supplies have been utilised, and, as in the Panjab, large schemes are required to command new territory. Neither in Bombay nor in Bengal does irrigation pay the State, but major works pay 5 per cent. in the Panjab and in the North-West Provinces, 7 per cent. in Madras, and 12 per cent. in Sind. It pays the Hindu everywhere, for without it millions could not live at all, and millions more would be decimated by famine every few years. Reckoning its influence upon the railways, commerce, and good government of the country its value is simply inestimable.

The great irrigation works of India are wholly constructed with borrowed money, raised in London, and charged to the works at from $3\frac{1}{2}$ to 4 per cent. The price need not be wondered at,

seeing that the guarantee of Government is behind the debentures. Though this of itself would suffice, there are the further facts that the money is spent in a populous empire, with an enormous revenue, and that the works as a whole are remunerative. In Madras, the North-West Provinces, the Panjab and Sind, they yield handsome profits; in Bombay they are likely to pay for themselves, and in Bengal, they are, after all, the cheapest and best means of fighting famine, and saving the public treasury from ruinous drafts in bad seasons. On the merits of the investment, therefore, the stock would be entitled to rank high, apart from the guarantee.

Before the colonies can hope to see their irrigation proposals regarded in the same light they must be able to satisfy the capitalists of the mother country that the outlay is reproductive, for, quite content with the credit of the Government, the Briton has never really considered either Indian or Victorian expenditure under this head. Except the directors of the Scotch companies, which have done well in Colorado and other of the American States, the moneyed men of Great Britain know nothing of irrigation ventures. The Madras and Orissa companies, if not forgotten, would certainly not have encouraged a favourable view, even in India. Those who lend upon colonial securities are entirely unacquainted with them, and are likely to regard State loans which are employed to benefit private lands with a considerable amount of suspicion. The debt of Ceylon is so light as to attract no attention, and the greater part of her irrigation capital has been drawn from revenue. Mildura should have an excellent influence upon investors when sufficient time has elapsed for its financial results to be gauged, but even its enterprising managers are understood to have had an unreasonable difficulty in getting their prospects appreciated by financiers here and at home.

Colonial irrigation has to justify itself, and those connected with it therefore must be upon their mettle in order to render its balance sheet above reproach. This does not imply that special consideration should not be given to the enterprise in its earlier years, and while its novelty tells against it, even with the farmers, but it does remind us that the new departure is to be judged by its profit and loss account, and that this will influence not only the taxpayers who are not irrigators, but those who make advances to us for the prosecution of reproductive public works. In this respect India has the advantage. The Madras schemes are debited with 3½ per cent., and the others, except Bombay, which takes 4 per cent. as the cost of its money, reckon at about 3¾ per cent., or at least one half per cent. less than ours are debited with under the law. Judging by recent events, no very early reduction of the rate below 4½ per cent. is to be hoped for in Australia.

The State in India means the Government in a deeper sense than in Australia, for in that country the citizens are unable to mould the Government to their wishes, having themselves practically no political opinions, and no political privileges whatever. Instead of

projects for the watering of a special area originating with the farmers, as in Victoria, and being subject to their specific approval. the Indian ryot, although in most cases he bears the same responsibility for interest upon the capital expended in providing him with an artificial water supply, is never consulted in any way or at any stage in the construction. Government initiates designs and executes the work, offering him the water if he likes to take it, and relying only upon his self-interest to induce him to become a purchaser. In the Panjab a system of compulsory labour prevails, and in Ceylon the sanction of the natives concerned is required before Government advances are made, but in each case this has regard to minor works, in which the State is little more than a sleeping partner. Upon all " major " schemes the Government acts of its own motion, at its own responsibility, and acknowledges no title in those who use the water to criticise its proposals. In an equally peremptory way it ignores riparian rights, or makes but small compensation for actual injury done or land taken ; not that this involves injustice, because the tenure of land is less absolute, and the property affected far less valuable than in Australia. The advantages of a despotic rule are exhibited in such cases as these, where the officers of the department are perfectly free to choose the best scheme possible, and to execute it without regard to the individual wishes or interests of their constituents. In the colonies these would be forced upon their attention at every step, and they would have to pay dearly for any encroachment, or imaginary encroachment. upon them.

Of course works of some kind, probably in the first instance inundation canals, go back before history, though it was not until the thirteenth and fourteenth centuries that any schemes pointing to the perennial canals of to-day appear to have been attempted. There are remains of large disused storages in all parts, and some still in operation are of great age, but the watering from these has never been relatively extensive. The primitive rain-filled tank, or little well, remain the chief sources of native supply outside the domain of the Government schemes. Millions of acres have been, and are, irrigated annually from them by the simplest means. It is to these, and not to the Mughal canals, or the tanks built by Muhammadan monarchs, that the people have trusted for ages. Almost every field had its own separate supply, the task of securing and utilising it forming the chief concern of the ryot, and the title to its possession being more important because necessarily implying that to the land which it made fruitful. The cattle required to draw water from the deeper wells form on this account a chief element of the farmer's wealth, and their capital value has assisted in certain districts to make a distinction between the proprietor and his labourers. The whole agricultural system, and in some degree the social system, of parts of India have been greatly modified by the practice of irrigation, but in ways which have nothing to teach us. The solitary inference to be drawn from a glance at the Hindu experience is that similar results are certain to follow in

Australia, where new principles of ownership, and fresh legislation recognising a property in water, are inevitable. It would be well if they were introduced at once, before more vested interests are created.

How widely the position of the farmer under the Victorian Irrigation Act varies from that of the Indian ryot under an irrigation canal, should scarcely need further exposition. The ryot has no responsibility except to pay for the water when he gets it, and even then may obtain a partial or complete remission if his crops fail. This may seem an ideal condition to the resident in the Goulbourn Valley, but it must be remembered that this immunity from risk is part of a system, and is purchased by serious disqualifications of another kind. The Victorian farmer within a trust area is responsible, not only for the water he may purchase, but for his proportion of the difference between the sum obtained from sales, and the amount necessary to pay 4½ per cent. interest upon the capital cost of his scheme, and of the national work, if any, which feeds it, after providing for working expenses. What he gets in return for this is the power of voting for or against a project in the first instance, and of shaping it afterwards to meet his view of present necessities, with the right of managing it economically, and so as to ensure justice for himself and those who live near him. Finally, if he pays his sinking fund long enough, the obligation upon his land for interest will be entirely extinguished, and the whole scheme will become the property of his children, who will be liable only for levies to meet its working expenses. The means of criticism which he enjoys attach to him it is true, not as a trust member, but as the citizen of a free community. Yet he would not have the power to make his criticism effective, as the mere unit of one constituency for each branch of the Legislature, in anything like the degree that he now enjoys as the constituent of a small municipal body, in which his personal influence can be directly exercised upon the scheme itself. Local control can scarcely fail to be more effective, as well as cheaper, than control from a distant capital by political agencies.

But perhaps the best criticism of the Indian system of sole State responsibility is to be found in the constant efforts to mitigate it. Wherever possible a village is dealt with as a whole, and required to settle the distribution of water, and all disputes arising from it. From Ceylon to the Panjab we find this practice pursued wherever feasible. The "headmen," as they are termed, in all settlements, are invariably encouraged to become answerable for the main administration, and, as has been seen, committees, or panch mahals, are especially created for the purpose on inundation canals. In every way legislation strives to throw upon the residents of each locality the task of settling their own affairs, and of securing protection to the works as common property. Even in the independent territories similar methods of local government, on a small scale, have sprung up, testifying in the strongest and clearest manner to the necessity which everywhere exists for it in connection with irrigation. It is not too much to say that so far as circumstances

permit the Indian system is being approximated to our own, though still conveying a very limited authority indeed to the ryot; that the associations of irrigators in France, Italy and America represent the development in a higher form of the same principle of local responsibility; and that the Victorian Trust system as it now stands is their ideal, and the ideal of irrigators all the world over.

State advances of cheap money for the construction of works, chosen and managed by those dependent upon their supply, represent as nearly as possible the perfect system for white farmers. Those who oppose it seek to diminish the responsibilities of the people concerned, and to cast them upon the general body of taxpayers, just as members of shires created and authorised to raise rates to make roads and bridges, ask that they may be built for them by the Public Works Department. There are instances in which an appeal to the public purse is valid in each case, but they are few and special. There is no just and no sane principle for the distribution of public funds except that they should be expended to benefit ratepayers in proportion to their contribution, or to the urgency of their special need. Local expenditure should mean local taxation, to raise the necessary sum, or pay interest upon it; any departure from this meaning the reduction of politics to a selfish game of grab. If the Australian is to cast all his responsibilities upon his Government he must endow it with powers equal to its task, including power over himself and his property, which would render him in some respects a mere ryot. If he accept the privileges of freedom and free institutions, he must bear his burdens for himself, in common with his fellows, and in conjunction with them. The alternative is to yield both burdens and freedom to the State.

It must never be forgotten that in arid Asia irrigation has been an essential, and whether in Persia, Afghanistan, or the region to the north of them, and whether in ancient or modern times, has supplied in a large measure the means of maintenance to its peoples. The oasis of Turfan, according to a Russian report published in *Nature* of this year, contains colossal works of the same character as those of Ontario and other places in California, bringing the water to the surface by means of tunnels or of wells, sometimes 300 feet deep. Sir Colin Moncrieff recently visited a part of the Russian territory where there are still to be seen remains of vast schemes constructed in a remote age, but it is understood that his report is unfavourable to any extensive attempt to reconstruct them. The canals and tanks of India were not undertaken for profit, nor yet merely to increase an established prosperity, but under the terrible pressure of necessity. Of course the production of the country cannot be indefinitely increased by such means, but it can be rendered fairly even, guarded against adverse seasons, and a reserve provided by means of an artificial water supply. Irrigation in India spells immunity from famine. There its mission begins and ends; and by this knowledge every one of its phases must be interpreted. The threatened failure of the Kaveri, and the actual failure of the Godaveri supplies, led to the initiation of works in the South, while

the several stages of irrigation progress in the North were marked in each instance by the recurrence of famines. That the schemes have been made to pay on the whole, and that the expenditure taken in the aggregate leaves good interest, is satisfactory, but it must be admitted that the State is in every case more lenient than private proprietors would be, and that taking into account the low charges, the frequent remissions, and the princely scale of many of the schemes, the marvel is that so favourable a result is secured.

Our own circumstances have offered but a faint reflex of these; we have had water famines, and we always shall have a considerate Government, abundantly content if it receives interest upon its advances to the farmers. But there the likeness ends, and it will not be until our population, multiplied many times over, comes to press upon the means of subsistence with a terrible intensity, that we can conceive the same urgency for expenditure on water supply for agriculture as has existed in Asia. Our irrigation is undertaken to develope new cultures, and especially highly-priced products, such as fruit and wine, while at the same time steadying farming generally, by guaranteeing pasture for flocks and grain for the mill, in droughts as well as in propitious seasons. This being the case, there is no need for any undue haste or excited adoption of undigested projects. We have made a good start, and what remains is to develope our water resources quietly but unceasingly on sound lines. This is not to be done in an instant; indeed, it is a work that will never be absolutely finished. The best executive officers reckon that their practice is altered materially every five years. Indian engineering is thoroughly progressive, and so keen are the wits, and so restless the energy of those employed upon it, that they are always leaving their former achievements behind, and pushing on to better things. It is not simply that each generation, brief as is its stay in the country, improves upon its predecessor, but the same officers confess that they have learned to avoid errors, to cheapen construction, and to make administration more efficient. There is now nearly a century of accumulated experience to work upon, although the great undertakings have only been commenced in the latter half of it, and still there is a buoyant confidence in the accomplishment of larger successes than have yet been gained, which is in itself one of the most encouraging features of the system, and a bright augury for its future. Although State directed and State controlled, there is no visible stagnation among the professional officers of the Water Supply Department. Australia will do well, therefore, not only to secure the present experience of the empire, but to take care to keep abreast of its developments from time to time.

To sum up then, the legislation of Irrigated India has not much to teach us, its administration little, its practices little, its relations of State department and people little, its agriculture very little, but its methods of construction, management of canals, conservation and distribution of water can teach us a great deal. The circumstances out of which irrigation began are not unlike ours, but we

may hope that its final outcome with us will be very unlike that which it is reaching in Asiatic realms, where it provides fresh food fast, only to find the population increasing faster, and not permanently rising, or likely to rise, in the social, moral or intellectual scale, to even a European standard. Given a rational and equitable riparian law, a generous encouragement to farmers who enter upon new cultures, or face the outlay necessary to prepare their land for irrigation, a keen supervision of Trusts by the department, and an intelligent criticism by their constituents of all their proceedings, coupled with such study and practice at our agricultural colleges as shall solve local problems in a practical manner, and there need be no doubt of the future success of irrigation. The French system of small holdings, Italian skill in dairy farming. American methods of co-operation, and enterprise in making markets, are well worth acclimatising, as are Indian engineering designs and devices. The outcome of the writer's observations in India are at least as stimulating and encouraging as those which six years ago were embodied in his report to the Government upon the irrigation of Western America. Clearly, existing systems have much to teach us, and it will be well for us if Australia, the last continent to be colonised by white men, and the only one built up solely by Anglo-Saxons, should come to be noted for its openness to new ideas, its freedom from the prejudices of custom, its readiness to adopt improved practices wherever they can be found, and its progressiveness even in agriculture. Our people have often been commended for the warmheartedness of their welcome to strangers, and if they can become, as well, hospitable in their thinking, methods of working and mode of living, acclimatising and assimilating the best of all that has been, and now is, they will make no ordinary history, and merit no ordinary reward.

APPENDIX.

CHAPTER I.

IRRIGATION IN CEYLON.

IRRIGATION has been practised in Ceylon for many hundreds of years, and upon a scale that, considering the size of the island and the difficulties which it presents is truly surprising. "Excepting the exaggerated dimensions of Lake Mœris in Central Egypt, and the mysterious basin of Al-aram, the bursting of whose embankment devastated the Arabian city of Mareb, no similar constructions formed by any race, whether ancient or modern, exceed in colossal magnitude the stupendous tanks of Ceylon," says Sir Emerson Tennant. One or two illustrations will convey an idea of the extent of these ancient operations. The Padivil dam is 11 miles long, 200 feet wide at the base, 30 feet wide at the crest, and in places 70 feet high. It was faced along its whole length with steps of large squared stone, and at the rates for native labour is estimated to have cost £1,300,000. The Kalawewa Tank was 40 miles in circumference, with an area of 6,000 acres, and contained over 3,000,000,000 cubic feet, or three times as much as the Yan Yean. The work requisite to retain this quantity was much more than three times that required on the Plenty. The dam had a length of 12 miles, averaging 50 to 60 feet in height, and was 20 feet broad at the crest. Anuradhapura, the former capital city, was supplied from this site by moans of a channel 40 feet wide and 53 miles long. In addition to this it fed innummerable tanks of varying capacity and constituted in itself a storage of no mean order. Two schemes in the north are of such dimensions that their restoration at the present time would absorb £200,000. They are now recommended to be carried out upon the old lines, which are still discernible. The Ambanganga River was dammed by a solid work of masonry 99 feet in top width, and rising 40 feet above the ordinary high level of the stream. An embankment was carried thence, from 40 feet to 90 feet in height, for 24 miles, forming a series of navigable lagoons, and then further prolonged by a canal for 57 miles more. Even allowing for the despotic authority exercised by the kings over their subjects, who were required in many cases to give their labour, the boldness of these designs

and their massive execution are still the wonder of the modern engineer.

A report of a committee of the Legislative Council in 1867 states that "the Sinhalese monarchs vied with each other in the construction of irrigation works and in giving every possible encouragement to agricultural enterprise. Vast tracts of country, now covered with the vegetation of centuries, once abounded in grain." The truth of this statement may be supported by the record of one of the kings, Prakrama Bahu I., who flourished about the middle of the twelfth century of the present era. This king constructed 1,470 tanks and 534 canals, and repaired 1,395 large with 960 smaller tanks and 3,621 canals. Some of the older works which he put into working order are believed to date back to 500 B.C., their original constructor being the son of a chief of the Ganges valley, well acquainted with irrigation in his own country, who landed with a small body of followers and made himself master of Ceylon. The feature of the Sinhalese system of supply, however, is akin to that of Southern Madras, and differs entirely from that of Bengal, since it relies very largely upon storage. There are to-day more than 5,000 reservoirs in the island, from which the cultivators derive their streams for irrigation, and almost the whole of these are situated upon the sites of former works constructed ages since. Its monarchs of that far time were faithful Buddhists who sought to give those practical proofs of their religious zeal which the great founder of their creed required of his followers. They decided, and wisely, that to a vegetarian race there was nothing so important as the assurance of certain and abundant harvests, and consequently put their whole strength into an irrigation policy. The works remain monuments to their piety and wisdom, combined perhaps with a natural proportion of personal pride in leaving such memorials behind them. Even British Governors and engineers in modern times have nourished a similar and not ignoble ambition.

Irrigation has been a chief article in the programmes of successive Governors, and their provincial officers have pushed it enthusiastically. There are six honorary titles in the gift of the Crown which are much prized among native notabilities, and by their means it is said that irrigation enterprise is rewarded and schemes are encouraged. The planters are inclined to complain that the paternal solicitude of the State is devoted too much to this one branch of industry, but taking all things into consideration it is hard to see how it could be otherwise. Other products might be encouraged, it is true, but rice is likely to remain first in the needs and tastes of the people.

The natural difficulties in the way of the cultivation of rice are naturally made much of by the opponents of irrigation, and even its advocates are unable to ignore their seriousness. It is a thirsty crop, and the provision of a sufficient supply of water by means of storage is therefore most expensive in proportion to area affected. Then again the rich deltaic soils of the Ganges and the Brahmaputra, with their annual floods richly laden with silt, secure crops which

are fifty fold to eighty fold of the seed sown. There is much argument as to what may be considered a fair return in Ceylon, and as rice is grown almost everywhere, there are, as is natural, very different returns. In some districts it is insisted that the harvest gives only four or five fold, while the average claimed is not more than fifteen to eighteen fold. It is confessed, therefore that the island is heavily handicapped in this regard, and cannot compete with the mainland. In 1888-89 India exported nearly 27,000,000 cwt., while Ceylon imported 3,330,000 cwt. Sometimes it has been questioned whether rice growing does not involve an absolute loss to the Sinhalese farmer, and very careful estimates of his working expenses and profits have been made. The result appears to show that in certain districts which are well irrigated, such as Matara and Batticaloa, it pays well, but that in others it yields only a bare profit. The doubt has arisen whether the limit of its payable production has not been reached, and certainly, the fact that some 6,000,000 bushels annually have been brought from India during the past few years would seem to lead to such a conclusion. On the other hand Mr. Elliott, the Government agent at Batticaloa has conducted some careful experiments in rice growing by means of hired labour in two districts with which he is intimately acquainted, and gives a balance-sheet which shows a profit of 40 per cent. in the one instance, and 70 per cent in the other. If such profits are open to the average cultivator, as many believe, there is still a fine future before the Sinhalese and Tamils of the low country, and the Government policy is abundantly justified.

That Ceylon should have adopted an irrigation policy at all is somewhat remarkable, but the form which it has taken is perhaps more remarkable still. Though separated from India by but a narrow channel of sea, the island has developed upon its own lines independently of its great neighbour. While in both countries the State has stepped in to aid the cultivator, and has undertaken costly works to provide his fields with an unfailing water supply, yet in Ceylon, owing to the cautious character of Lord Grey, it has done so with certain reserves, and only upon conditions of local responsibility. When it is remembered that the population to be dealt with is entirely Asiatic, and that the forms insisted upon are those associated in Europe with responsible Government, the difficulty of the task imposed may be appreciated. A short reference to the circumstances under which the policy was developed in the first instance may lead up to a better understanding of its present character, and of the important conclusions to which it points.

During the earliest ages the Sinhalese had developed an irrigation system on the greatest scale. As the official report for 1888 says:—"There is no part of the island, except the central mountain districts, in which the remains of canals and tanks are not found; but whether the whole island . . . was ever at any one time under cultivation, as some suppose, or whether the population, abandoning or driven from ancient centres of habitation, gradually migrated from one district to another, erecting new works where

they settled, and allowing the old ones to decay, is a disputed question. The fact, however, that almost all irrigation works are found on investigation to form but parts of large connected systems. affecting great stretches of country, would appear to favour the former supposition. . . . . The Yodiela (canal) itself, 54 miles long, is only one link in a connected chain of tanks reaching far north and westward. . . . . Another system, as yet only partially explored . . . . extended from the foot of the Central Mountains to the sea on the south cost; while the remains of ancient cities, which are frequent in Uva, show that the country was once highly cultivated by the agency of canals, the remains of which are often crossed when traversing the forest." During the period of the Tamil invasions of the thirteenth century many of these were destroyed and others neglected so as to soon destroy themselves. The Portuguese were blind to their value and guilty of wilful vandalism, though the Dutch who succeeded them were enabled from their own experience to appreciate the navigable canals and take some steps for their maintenance. Still little was done, and the island which had maintained according to the records no less than 5,000,000 people, was unable when its irrigation was restricted to support more than 750,000.

The British had scarcely taken possession before the cause of the national decline was discovered, and proposals were made even as early as 1800 for the restoration of some of the works. With customary deliberation successive Governors debated the question. and in 1832 it was referred to a commission, which, actuated by a laudable desire to free the people from the oppression of the *corvée*, or contribution of forced labour, recommended that not even her Majesty should be authorised to demand it for the future without payment. As it was by this means that the works had always been maintained the ruin of many of those remaining speedily resulted. "Each cultivator was ready to grumble and complain that his neighbour would undertake no work of repair; but he was firmly resolved to do none himself so long as his fellows refrained from doing their part also." In 1846 Sir Emerson Tennant, then Colonial Secretary, endeavoured to awaken his superiors to the necessity for action. In 1847 he obtained a recommendation from a committee in favour of the repair of old tanks, and immediately afterwards tabled a proposal to apply portions of the road funds to this purpose.

Lord Grey emphatically refused to follow a diversion exactly equivalent in Australia to the application of municipal rates to water supply purposes, and in a minute of 1849 laid down the principles upon which he would insist before authorising a new departure in State interference. His first condition was that the cultivators themselves must be consulted and form for the purpose a local body, and the second was that the works, being for the benefit of a particular body of persons in a particular locality. those thus favoured must bear at least a portion of the cost and maintenance of the scheme. The immediate effect of these requirements and

of political exigencies was to delay the initiation of legislation for six years; not that it was impossible to comply with the conditions, for, indeed, in some respects they had long been anticipated.

Every village in the island had possessed for centuries a kind of assembly of notables and elders, to whom all questions of common interest were referred. The absolute necessity for joint effort in connection with irrigation had been felt, and at a remote period a complete system of administration had sprung up, of which the tradition remained where the works had been destroyed, and the practice where they were still in existence. All land-holders were compelled to do their share of repairs or else they were refused water. They were forbidden to irrigate fresh fields unless there was a surplus available, and in a season of drought were allotted only a fair proportion of the diminished stream. The rotation of watering and the order of supply were strictly determined, and thefts of water or breaches of custom promptly punished. This communal system was readily revived when the need arose. The mere fact of its existence and persistence in the island, reiterating as it does the lessons of French and Italian experience, is full of significance for Australia. It offers another evidence that, to parody a French saying, if local bodies did not exist for other purposes it would be necessary for the sake of irrigation to create them. There must be some organisation such as that of the Victorian Trusts, no matter what part the Central Government may take in securing or distributing water supply.

Sir William Ward was the Governor to whom Ceylon owes its first ordinance on irrigation, dated 1st January, 1857, and in force for five years afterwards. The measure was tentative in character, and provided for little more than the revival of the ancient customs for obtaining and regulating a water supply whenever a two-thirds majority of the landed proprietors of any district approved. It was really applicable only to parts in which rice cultivation was already proceeding, in which there were comparatively few proprietors, and they happened to be unanimous. It was successful, therefore, only in one or two places, and supplies a parallel in several respects to the first Victorian Irrigation Clauses of 1883. In 1861 the same ordinance was renewed, with slight amendments, for another period of five years, during which time the same difficulty that was and is felt at Victoria, when an influential minority opposes the legalisation of any scheme, was keenly realised. Sir Hercules Robinson, who was in office in 1867, accordingly endorsed a measure in that year which destroyed the power of the minority to permanently obstruct. It provided for a vote of the land-owners for and against the establishment of irrigation districts to decide the issue, and for their control by a village council or head man under by-laws supported by penalties. Most important of all was the authorisation of the advance of money by the State for expenditure upon private lands. This at once indicated a new departure of a momentous kind. Taken as a whole this ordinance resembles the Victorian

Act of 1886. Curiously enough it was largely founded, as that was, upon the report of a commission whose recommendations were more generous to the cultivator on some points than the Act itself proved to be. While free grants were suggested in Victoria, the free construction of minor works costing less than £100 was urged in Ceylon.

Sir Hercules Robinson remained faithful on the whole to the policy of Lord Grey, making one concession, however, which is more liberal than anything yet granted in Victoria. The capital required by the farmers to construct irrigation works was to be obtained from the State and repaid by 10 per cent. instalments in 10 years, but the advance was made for that period without any interest. The representative of the Tamils in the Council contended that even this treatment was not sufficiently liberal, inasmuch as, in his opinion, the rice excise and increased land rents would amply repay the Government for its outlay. As it stands, the Government of Ceylon, by its gift of interest and by its departmental expenditure, will have probably paid as much towards a scheme ten years after its execution as have the farmers who directly benefit by it. This is handsome treatment.

The success of the Ordinance of 1867 has been unquestionable. During Sir Hercules Robinson's term of office £105,000 was advanced or expended under its provisions. Sir William Gregory proved as energetic in this direction as his predecessor, a further £121,000 being provided under his administration. His successor, Sir James Longden, was a less vigorous ruler, but £117,000 was spent during his reign. Sir Arthur Gordon, who took office at the end of 1883, imparted fresh life to the policy involved in this class of public works. In 1884 a further concession was made to the irrigators, who were allowed the option of accepting a permanent rate of 2s. per acre in lieu of the obligation to repay the capital advanced to them in 10 years. This rate also provides for maintenance and repairs. In other words the Government made a permanent loan of the sum spent on the works, contenting itself with the receipt of its bare interest and cost of management. This is the Victorian system, minus its sinking fund and its compulsory acceptance of, and payment for, water. Assuredly if the operation of the rice tax and land rent be rendered equitable in themselves, the native farmer of Ceylon who irrigates cannot complain of the treatment he has received from his Government. There is nothing so liberal to be found in America, Europe, Egypt, or Australia.

In 1889 the existing ordinances, five in number, relating to irrigation and rice cultivation, were repealed and replaced by a consolidating measure which to-day embodies the law in Ceylon upon these subjects. It commences by establishing a series of provincial irrigation boards and a Central Irrigation Board. As is natural in a Crown Colony, these boards are nominated, consisting of Government officers and any other person or persons whom the Governor chooses to appoint. The settlement of the question as to whether an irrigation scheme shall be adopted or not, is left to be decided by a two-

thirds majority of the local land-holders within its boundaries, who must represent at least one-third of the acreage to be benefited, or by the votes of those who own at least two-thirds of the acreage to be watered, irrespective of their number. This is exactly parallel to the Victorian law, which more strictly requires in each case the endorsement of a majority in number of proprietors, owning at least one-half of the area to be included. The application from owners to be lodged with the provincial board, like that furnished to the Victorian Department, must give the names of the proprietors and the allotments proposed to be watered. The preparation of plans and estimates rests with the provincial board, and if these involve an expenditure of not more than £250 they are empowered at once to make the advance; if the cost exceed that sum the proposal, with all necessary particulars, goes to the Central Board, whose decision is final on the question, just as that of the Executive Council is final in Victoria. That assent in our case is conveyed to the public through the *Government Gazette*, while in Ceylon the law requires that it should "be published in each village affected by the work by beat of tom-tom."

The funds available for irrigation each year are apportioned among the provinces. It was for some years the practice to charge the watered land with only the estimated cost of the works, but that has now been abandoned in favour of the Victorian system of charging the exact cost. Farmers in Ceylon are given the option of executing certain earthworks themselves so long as they are done to the satisfaction of the officer in charge. This enables them to claim a grant of a certain amount of money, or its equivalent in works, at the expense of the State, and is a provision of which much advantage is taken. Land required for any scheme may be acquired on payment of compensation. The capital cost of a scheme may be repaid in ten yearly instalments, and in that case the works are maintained by the Government for 2½d. per acre, per annum, or a perpetual rate fixed by the Government, but not exceeding 2s. per acre, may be paid for both interest and maintenance. The debt, as in Victoria, is a first charge upon the land, which may be seized and sold if the proprietor be in default. The setting aside of one-fourth of the grain tax as a special appropriation for irrigation works, and the appointment of village councils or head men, are peculiar to Ceylon, but in other respects the ordinance bears a most remarkable likeness to the present Victorian law. Our Parliament has never suspected that the main principles of our act were anticipated in this Crown colony, but such is the fact. The similarity speaks strongly in favour of the principles thus mutually but independently approved. The last addition to the policy in Ceylon is the appointment of a Central Board charged with the function devolving upon the Minister in Victoria. It is within the bound of possibility that the admitted success of the ordinance in this particular may be hereafter worthy of very careful consideration by our own Legislature.

The great difference in point of practice between the two countries is that the State in Ceylon not only offers greater inducements

to its irrigators, but that it does more for them. It is the State that constructs and maintains the works—instead of the Trusts. All that the individual does is to undertake to pay the rates levied upon him. Although the village councils are greatly relied upon in the island, it is, of course, impossible to compare their capacity for self-government with that of Australian shires. The authority which is properly placed in the hands of the Victorian farmer over the design and management of the scheme in his district, like that of the irrigator in Lombardy, Piedmont, and the south of France, is very considerable. Such a power could not with safety be entrusted to the Tamil or Sinhalee. They must be content to remain under control for some generations to come. The native can accept or reject a scheme, and provide for its minor administrative duties, but beyond these he must trust to those who are placed over him, and accept their judgment as to what is most for his interest.

In one other respect the experience of Ceylon is worthy of remark. It was the suggestion of Lord Grey that the irrigating systems of other countries should be studied with a view to their application so far as they might be suitable to Ceylon, and Sir Arthur Gordon notes that it was to the inquiries of Mr. T. Bailey into Indian and Italian methods that much of the first success of the movement was due. The first ordinance was based upon his report, and it proceeded upon lines which experience has amply justified. If we are not as successful in Australia it will not be from any want in this direction. The articles of Mr. J. L. Dow, M.P., and of Mr. T. K. Dow, together with the reports published and circulated gratis by the Victorian Government, including the recent letters of Mr. West, have familiarised those who read them with the practices in the United States, Egypt, and Italy, while Mr. Ward has preached the gospel of irrigation with graphic power in New South Wales.

The one hostile criticism offered in the island against its policy of irrigation has been levelled only against schemes which were new and large, and against the undue encouragement alleged to be offered to rice growing. Smaller works and restorations of a minor kind have been expressly approved even by opposition critics. The general public appears to be well contented with the policy. Those who can claim to speak on the subject free from all official trammels, such as Hon. J. J. Grinlinton, M.L.C., an old resident who enjoys the confidence of the natives to a remarkable degree, and who has taken an active and independent interest in public affairs for many years, assert that the system as a whole, whether from a political or professional point of view, is a complete success. The task of the Central Board was declared by itself to be one of no early or easy fulfilment. "It is to the gradual and patient renewal of the ancient irrigation systems of a whole district, utilising every drop of water available, that our efforts should be directed. It is by this means that the crops of a district are multiplied manifold and secured from failure; that many forms of disease and extreme want are banished; and that the health, wealth, and comfort of the people are permanently assured." With what has been done to give effect

to this programme its members have expressed their cordial satisfaction in one of their published reports, in which they testify that in Ceylon irrigation has already "meant health instead of sickness, comfort instead of starvation, in many cases life instead of death."

The circumstances of the island have called for designs of a special character. The rivers of Ceylon are solely rain-fed, for though hail is occasionally seen, there is no snow. The largest of its streams has a drainage of 4,000 square miles, is 134 miles in length, and reaches the sea near Trincomalee. It was not because of the deficiency of precipitation that irrigation was employed in the east and to the north, where it most flourishes, but because its timeliness could not always be relied upon. The rainfall on the coast is 88.85 inches. The cultivated areas of the low country have a mean of 32 inches, while in the mountains 2,000 feet above sea level it rises to 217 inches as the average of nine years. The important circumstance connected with the rainfall is the largeness of the fall in very short periods; 9 inches to 12 inches during the twenty four hours being experienced occasionally in many parts of the island. Eight inches per day for four consecutive days has been actually measured. The monsoon pours itself over the land in torrents, which cut for themselves deep channels of rapid escape, and at times flood a whole country side, though dry for the rest of the year. It is this condition which renders storage essential to all irrigation, and the immense reservoirs of the past were constructed accordingly to impound these enormous downpours for the use of farmers during the dry season.

It may be noted in passing that the violence of the rain storms necessarily denudes the higher lands and heavily charges the streams with silt. This collects at the mouth of each river, and forms a bar which diverts it at last for some distance parallel with the sea, though from time to time it forces a new outlet. Along the coast there are stretches of lagoon country closely resembling the sea-frontage of Gippsland from Lake Denison to Cunninghame, with its chain of shallow and brackish waters divided from the ocean by a narrow strip of made ground. A somewhat similar phenomenon may be observed on the eastern shore of India, from Madras northwards to the Godaveri. Both there and in Ceylon these lagoons have been improved and utilised for navigation.

The basis of irrigation in Ceylon is the tank. There exist throughout the low country an immense number of minor storages, from each of which one or more fields are watered. Often the smallest are dependent upon their own little catchments only. The larger, however, both in ancient and modern times, were seldom constructed unless it was possible to supplement the supply from a stream or to connect a chain of tanks so as to minimise the possibilities of failure in dry seasons. The tanks themselves were always rudely built and often insignificant in capacity, but the headworks of the system consisted, and consist, of a large reservoir or an expensive weir, with probably channels of considerable size to or from it. In the past, according to the testimony of more than one district

engineer, by means of elaborate connections and distributories, every driblet of water was employed, and it has been the best hope of recent Administrations to be able to restore the schemes which made this economy possible hundreds of years ago. There have been already 2,250 small tanks repaired by British engineers, without counting those which have been indirectly benefited.

These restorations have involved the reconstruction of 59 large reservoirs, of 245 anicuts, as weirs are here termed, and of 700 miles of canal either partially or wholly renewed. Many of these works are of notable dimensions. The Kautalai reservoir irrigates 25,000 acres, the Walawé-ganga weir commands 10,000 acres, and the Tissamaharama tank 2,000 acres. The famous Kalawewa storage has been once more brought into use. Its by-wash has been raised to 20 feet, giving a water surface of 3,300 acres, a contour of nearly 32 miles, and a capacity of close upon 2,000,000,000 cubic feet. By raising the by-wash another five feet the quantity retained can be increased by over 50 per cent. It can irrigate 23,000 acres, and if enlarged could do so through the longest drought ever experienced in its neighbourhood. It feeds eighty tanks and commands a large area of country. Such works as these may be taken as illustrative of the scope and character of the engineering ability of the ancient Sinhalese and of the present Department, which has in Mr. M'Bride a highly competent chief, whose name is already associated with a reform of the system of macadamised road-making by which 50 per cent. has been saved to the State, and the reputation of the island for the excellence of its highways fully maintained. Much, however, remains to be done before the work of restoration is completed. Mr. Grinlinton considers that £500,000 would finish all the schemes that are at present called for, but this would probably prove to be under the mark. Mr. Vines, the able engineer in charge of the chief province, speaks of a native canal, 40 feet wide and 40 feet in depth, of which he has traced the course, and it would require but a few works of this class to be added to increase the present estimate.

It is not to be assumed that Ceylon has proved an exception to the universal rule that experience has to be paid for in the inauguration of any new enterprise. The history of its engineering discovers miscalculations, such as that with regard to the capacity of Tissamaharama, which proved to be but one-fifth of the estimate. The surveys at Adichchikalu were so faulty that the progress of the undertaking was stopped altogether. The Elahera canal by no means realised expectations, while more than once the Governor has had to complain of the under estimate of the cost of works in one part, or the indifferent execution of in another part. Sir William Gregory, speaking upon this point in 1874, said, "I cannot attach blame to any person connected with these works for these insufficient estimates. I blame the system. The great object of the then Government was to get irrigation set on foot without delay." There has been the same anxiety in Victoria.

but the errors discovered pertain less to the works than to the purposes to which they were limited.

Neither is it to be assumed that the great works constructed have been immediately successful. As a matter of fact in every case the utilisation of the supply provided has been gradual. Recognising this the Government has made liberal concessions to those commencing to irrigate. It charges no rates for four years, foregoes interest for ten years, and makes free grants in connection with small tank construction. If the natives construct the earthwork of a tank the Government gives them gratis a masonry bywash, or spill water as it is termed, and an outlet of cement pipes. These concessions are greatly appreciated by the inhabitants, especially the last, one officer reporting that in the Matalé district during 1888-89, while the Government expenditure was £1,295 that of the natives in labour was worth £1,998. Up to 1889 the earth work done by them in this way amounted to over 6,000,000 cubic yards. Yet even with these concessions, those who are most satisfied with the policy pursued consider that time must be allowed in every instance for the development of every considerable work. Several of those now classed as successes were held to be failures for some time after their completion, and one district controller goes so far as to say that twenty years is necessary to determine the true value of each great scheme. Impatient critics in Australia are not likely to be persuaded by him to hold their peace for such a protracted term.

So many of the Ceylon works are restorations that the sums expended occasionally appear disproportionate to the results obtained, since no allowance is made as in Madras for the value of the original work embodied in the new scheme. Then the expenses of maintenance require to be deducted from the annual totals, so that the total capital invested, and upon which interest should be earned, can be roughly set down, making allowance for all kinds of outlay. at £500,000, for which 100,000 acres are being permanently watered. This is a high rate per acre; higher than that of the Victorian authorised schemes and national works, in spite of the fact that labour can be obtained for a wage of fewer pence per day than we pay shillings. The explanation is that rice is a thirsty crop, requiring according to Mr. J. R. Mosse, M. Inst, C.E., late director of public works, a cubic yard of water to every square yard of ground, or thrice as much as is likely to be required in Australia. This of course, increases the acreage cost proportionately.

Labour in Ceylon is not merely cheap, but in many respects good also. The present head of the Irrigation Department considers that for either earth work or stonebreaking the Tamil is equal to the European. But the labour has its peculiarities. It is not males only who are employed; whole families work together. On the roads, in the rice fields, or in the plantation, the women are side by side with the men, taking the lighter share of severe exertion, but bearing most of the burdens. Children, so soon as they are able, work with their parents. None of them are violent in their exer-

tions, but their efforts are sustained, and are continued in most cases, with little intermission, from dawn till dusk.

Other conditions are equally novel to us and render comparisons unprofitable. Communal labour is frequent and there is a good deal of communal proprietorship among the villages. Inheritances of real estate are often, on the French method, divided equally among children, and joint partnership becomes so complicated that a suit has been conducted in the courts in which the subject of litigation was the 2,520th part of ten cocoanut trees. Machinery is unknown, except the rudest kind of water lifters, and the implements of agriculture are of the simplest. The native is a stolid conservative in opinions and practices, and though thus evidencing the limited range of his ideas cannot be condemned altogether for his adherence to traditional practices. He knows what just suits his present style of living, and has no ambition to alter its general character. If he possesses sufficient for the day he is contented. and prefers to obtain that sufficiency in a time honoured way, rather than venture upon a change that promises a better return to greater perseverance.

Irrigation has therefore in Ceylon a series of obstacles in the way of its progress, owing to the inherent conservatism of the irrigators. Some fine tanks constructed by the Government, notably those in the western districts, Magalawewa, Galgamuwa and Mahauswewa, have remained for some time unutilised, because the Sinhalese decline to leave their present homes, which are at a little distance, in order to take advantage of the storage. Fortunately the Tamils are more enterprising, and the force of their example operates, though slowly, upon their neighbours. Another and greater difficulty arises from indolence and greed. Even rice, though an amphibious plant, may be overwatered, and partly from carelessness and partly from the desire to take all the water they can, many of the Sinhalese drown rather than irrigate their crops and suffer accordingly. The low yields often complained of, arise as much from bad farming as from any other cause, for when skill and caution in the use of water go together, the best irrigators obtain twenty fold and thirty fold. The silt in the low country is a valuable addition, but in the mountains the streams are clear, except when there are plantations above. The clearing and cultivation of the planter occasion a sediment in the streams near his estate, which is distinctly traceable below; a fact which has a direct bearing on the influence of forest cultivation, and the necessity for reservation of land above all town supplies.

The Sinhalee is sometimes a bad farmer, and very often a bad engineer. Thus a Government agent is compelled to report that "The distributing channels have apparently had no attention paid to them, the old native courses have been adopted, and the development of new ones left nearly altogether in the hands of the Vanniyas. These men know nothing of levels, and consequently do not always select the best line, though the people are very energetic and willing to spend money to obtain water. To secure this in many places the

level of the surface of the fields is reduced several feet, with a loss, of course, of the best soil which is heaped up in banks." There is little or no excuse for such blindness as this discloses. Water will reach its own levels. Other conditions are quite favourable. The red soil of the uplands must be very stiff since it permits channels to be constructed with a fall of over ten feet to the mile without erosion. The narrow cheeks made to retain the flow in the rice fields appear to maintain their consistency very satisfactorily, so that the natives have an easy task before them if they supplement these many natural advantages by knowledge, judgment, and energy.

The problem in Ceylon relates for the future less to irrigation than to the irrigator. The law is liberal; its administration intelligent, and its results admirable. The market is favourable, and success is only limited by the courage and capacity of those for whose use the water has been diverted or stored. Fast as rice cultivation has extended, population has increased faster, and the imports grow year by year in spite of the duty. Everything, therefore, waits for the cultivator, everything is ready to his hand, he has but to stretch it out to grasp his reward. Before we reproach him for his tardiness and timidity we had better, perhaps, assure ourselves that in Victoria we are not open in some degree to a similar criticism even at the present moment.

CHAPTER II.

IRRIGATION IN MADRAS.

Madras is entitled to a high place among the Presidencies in regard to its irrigation, for it possesses practically the oldest, the largest, and certainly the most profitable of all the systems. It can claim to have introduced, if not originated, a style of construction which has been widely adopted within and without the Empire, and to have established a plan of dealing with deltaic lands which has not yet been improved upon. A portion of the credit for these achievements belongs to the native engineers of the days preceding the British advent. They had conceived the idea of controlling a river at the head of its delta, and of thus securing the regular watering of their lands. At the head of the Kaveri a weir, or as it is termed, anicut, having been constructed by one of the early princes, the importance of the work was celebrated in verse by one of his poets, fragments of which still survive as a tradition in its neighbourhood. Upon such suggestions and illustrations the English engineers proceeded when in the early part of the century it became evident that the native works were ceasing to perform their office owing to the changes of the river courses.

It would be a mistake to suppose that, even now, the elaborate systems of the European have supplanted the primitive works and methods, by which, in periods before history, the Dravidians, and perhaps those who preceded them, supplied by artificial means the want occasioned by a deficient or irregular rainfall. It would be impossible to number the wells from which wherever water is to be found it is raised by the Egyptian lifter or by bullock draught. The official report indicates that upwards of 3,000,000 acres are still watered by what may be termed private means. Besides wells these include 60,000 tanks or reservoirs, in which the heavy rain-bursts are preserved to be utilised in dry weather. These are of all sizes, according to the catchment, and serve for the watering of an immense area. Nowhere else in India is there such a multiplication of minor storages. A calculation has been in circulation for some years, in which it is estimated, that if the embankments constructed with this end, within the Presidency, were added together they would make a wall of earth, six feet high, once and a half times round the globe. Seeing that many of these tanks depend upon the rainfall of a single year, and all of them upon that of two

or three years at most, the risk run by immense numbers of farmers and immense areas of cultivation may be fully appreciated. Still as no more is possible the ryots are compelled to preserve this very imperfect system, and a paternal Government, recognising the straits in which they are placed, sets apart every year considerable sums which are expended upon the more important tanks, when, through neglect or faulty construction, they have proved incapable of meeting the demands made upon them. Silting-up is always proceeding, and after a time the older works are found to have lost most of their usefulness. In 1888-89 nearly £60,000 was expended in this way. Rivers require to be embanked here and there, or drainages to be provided from time to time. These are put together under the head of "Agricultnral works." The outlay under this head amounted in 1888-89 to £45,000 of which one-half was upon rivers.

The reports of the Madras Irrigation Department are in some respects the best in India, for though all the provinces publish admirable records of their work, these are exceptionally lucid and well arranged. A glance at the map prefacing the annual report indicates at once the position and character of the great State undertakings for water supply. At the extreme north, where the east coast curves eastward to Orissa, is the Ganjam and Gopalpore tidal canal, undertaken as a famine relief work, the estimate for which is £50,000. Southward, two important rivers—the Godaveri and Kistna—pour their stream over two large tracts, which unite to form a great irrigated area. A long narrow strip in the mountains indicates the one private enterprise, the Madras Company's Canal, while the Penner River to which it leads, has at its mouth its own deltaic scheme. There are three smaller patches near Madras, and one in the interior at the Barur tank. Then come the great delta of Tanjore, watered by the Kaveri; at the extreme south, another delta below Tuticorin, and between the two, inland the plain of Madura, to be commanded by the great Peryar project, now in course of construction. The five great schemes are deltaic, and similar in character, repeating here, as in Bengal, the likeness and lessons of the country below Cairo. If Egypt is the gift of the Nile, certainly Bengal is the gift of the Ganges, while the Godaveri, Kistna, Penner, Kaveri, and Tambrapani, have endowed the Coromandel coast with stretches of remarkable fertility which have enabled its millions to be certain of their harvests year by year.

The water supply expenditure in Madras is dealt with under several heads, distinguishing works which were undertaken as reproductive investments of capital, from those which were executed to protect the country against famine, and from those which were expected to yield some return incidentally, but were not commenced solely with that end. Under the first head "Major productive works," the Presidency has invested £5,300,000 up to the end of 1889-90; upon "protective works," £160,000 and upon "minor works and navigation," £1,200,000. After allowing for interest

upon capital, the first class show a profit to the State for the year, of £275,000 on five schemes, and a loss of £102,000 on four, or a total net gain of £173,000. The net revenue, after deducting interest charges, is 7 per cent., and would be 12 per cent., if the department were responsible only for the works designed and executed by its own officers. Nearly 6,000,000 acres were watered during the year, of which 2,300,000 were under major works. The direct revenue derived from water rates was over £1,750,000, even after deducting remissions to the extent of £100,000. Many of the areas now commanded by State works were irrigated prior to their construction, and in each case the value of the work done in those days appears upon the accounts. Nor is the result in any sense unfavourable to the administration, for by means of the new works areas in which there were but 1,000,000 acres irrigated have now nearly 2,250,000 acres, while the revenue they yield has risen from £90,000 to over £500,000. The official estimate of the value of the crops in the one-third of the whole irrigated area which is supplied by major works, is just short of £5,500,000, and if the remaining two-thirds be only taken at the same sum this means security for £11,000,000 a year. Such figures should convey to the mind of the Australian the magnitude of the system of irrigation executed in this one Presidency—which is, after all, only half the size of New South Wales and not twice the size of Victoria.

In some respects the larger works in Madras are typical of those throughout India, in that they are often built upon sand or clay foundations, across rivers of great width, and of inconstant volume, are not remarkable for height, and permit the passage of enormous floods every year. They can be best illustrated in a general way by an outline of the dimensions of one or two of the more famous. The first and greatest, which supplies the Tanjore district, has been dealt with separately. It was after his success there that Sir Arthur, then Colonel, Cotton, was authorised to report upon the possibilities of some northern projects. About the close of the last century Mr. Topping advised the Government upon the possibilities of the Godaveri delta, which stretches into the sea, in a semi-circle, with a length of forty miles, and an area of 2,000 square miles. The river which has built up this rich territory is one of the largest in the Empire, having a flood discharge of 1,210,000 cubic feet per second. The people of the place, even while under native rule, had not been blind to the natural advantages of the site, and had excavated two channels from which, during high river, they could flood 82,000 acres. This was possible for only fifty days in the year on an average, sometimes not so long, and in spite of it a disastrous famine overwhelmed the population in 1833-34. After this the ryots seemed to lose heart, the works were neglected, population diminished and the revenue fell proportionately. It may emphasise the value of what has been done here to state at once, by way of contrast, the present condition of the district. A million and a quarter sterling has been spent, which earns its own interest and puts 9.33 per cent. profit into the public

treasury. The area irrigated in first and second crop amounts to 670,000 acres, of which 466,000 acres were never watered before the construction of the weir, while there is an accumulated net surplus revenue of £2,338,000. The population has not merely multiplied, but enjoys a higher standard of living. The productiveness of the spot furnishes one of the strong arguments in favour of the construction of the great railway from Madras to Calcutta already authorised. Taking all things into consideration, it may be questioned if there is a more beneficent or more profitable public work in the world.

The headwork is constructed where the river, divided into four channels by two islands, is nearly four miles broad. There are four weirs in all, respectively 4,940 feet, 2,860 feet, 1,548 feet, and 2,598 feet in length, constructed of masonry, and united by embankments carried across the islands. The greatest height of these is fourteen feet. Besides locks, the work has three head sluices, the eastern of 624 square feet, the central of 765 square feet, and the western of 654 square feet capacity. The delta is fully supplied when three feet of water flows over the crest of the anicut. In 1889 it was above this level for 154 days, and attained a maximum height of twelve feet above the weir. The maximum height yet reached in flood is sixteen feet. There are 506 miles of main canals, of which 496 are navigable, and 1,733 miles of distributaries. The maximum carrying capacity of the canals is 8,879 cubic feet per second, and the annual rainfall thirty-one inches, while the culturable area commanded is only 150,000 acres more than that at present watered.

It would be a mistake to suppose that the works as they stand are a copy of the original design, or that no errors have been made in the calculations. It would be an unprofitable task to recount them in detail, but it is necessary to note that Major Cotton greatly under-estimated the cost of the work, and over-estimated the duty of water; built the weir too low in the first instance, and adopted an unsatisfactory expedient for raising it in the second. Parts of the work have been carried away, and replaced or altered, while the extension of the canals has been proceeding from 1848 practically up to the present time. The maintenance even now occupies no less than 216 boats, including four steamers and eight steam dredgers, the value of the floating part being £55,000, and its annual cost £2,258. The reports every year note the construction of new works, whether as improvements, additions or alterations. Very little Indian experience is required to show that a great irrigation scheme is essentially a living as well as reproductive work. It is never created at a blow, but invariably develops, and implies constant care, control and amendment, as well as constant expenditure. Nevertheless it may not only pay such expenses, but leave a superb profit as well.

The Kistna scheme, on parallel lines, and in the immediate neighbourhood of the Godaveri needs but little comment. Its river has a somewhat smaller delta, and a maximum discharge of 736,000 cubic feet per second. It is weired at Bezvada, where two rocky

hills confine the stream to a channel 1,300 yards broad, by a masonry anicut 22½ feet above the bed of the river, and 15½ feet above its summer level. This is built upon a double row of wells 4½ feet diameter and seven feet deep, is six feet wide at the crest, coped with cut stone, and has an apron 257 feet wide. Its exact length is 3,712 feet, of which 3,198 feet is effective, and has on each side fifteen under sluices of six feet vent, with head sluices of the same dimensions, that on the west being six feet, and that on the east five feet six inches below the top of the anicut. It has been the practice to add a temporary stone wall along the crest each year, so as to raise the water another four feet. A foot of concrete, in which are embedded iron posts, has been substituted on part of it and the experiment will be tried of raising the water by means of planks between the pillars. What was said as to the gradual progress and occasional blunders of the Godaveri works applies equally here. As much as twenty feet of water has passed over the anicut, which now operates practically all the year round. Before it was constructed there were but 19,000 acres imperfectly and irregularly watered from the river, and altogether 69,000 acres wetted from all sources : while now 364,000 acres have been added. There are 370 miles of main canal, of which 339 are navigable, and 848 miles of distributaries. The accumulated surplus is over £1,000,000, and the gross return sixteen per cent. on capital. The net revenue for 1888-89, after deducting interest and all charges, is £82,269, and the net profit 8·66 per cent. upon the investment. Need there be any further demonstration of the profitableness of irrigation in Madras ?

It would be wearisome to repeat figures which, after all, could only convey the same general knowledge. while the detailed descriptions of works and methods would belong more properly to the engineer. The two schemes referred to are after that of Tanjore the best, largest and most profitable. They make the annual reports of the Department pleasant reading. Their success has been inspiriting in India, and should be so elsewhere. But their products are not such as are likely to be grown in Australia, the chief being rice and indigo. Mr. Keess, the chief of the Agricultural Department of the Presidency, considers that in cultivation the ryot has much to learn, but that in irrigation white men have nothing to teach. Consequently while at Saidapet there are experimental plots where all known crops are tested, there is no provision made for experiments in irrigation, though the failing plants are watered when necessary and the charming little botanical garden regularly. Mr. Keess is enabled to show that deep ploughing in certain soils produces stronger crops, that the planting of indigo is imperfect. and that a light iron plough drawing one furrow does quicker and better work than several scratches made with the native implement. According to his view, it does two months' native work in two days. Cotton, which only yields the ryot an average of 70lb. to the acre. gives 150lb. on the farm. Mr. Keess gets a better stalk on his millets, a better yield in his grams, better milk from his cows, and raises. even on the poor soil of his farm, many medicinal and other plants

unknown to the coloured cultivator ; but for all that is not quite satisfied with the fruits of his labours. Of his seventy students too many are Brahmans unconnected with the farming class, while the Europeans, Eurasians, and native Christians especially, make poor progress. It is but very slowly that real practical knowledge and aptitude is being developed among any of those who come to him. The Government accordingly has resolved to alter its system. There are to be four local schools, where the ryots' sons are to receive a rudimentary training almost in the field, and only after that are they to come to Saidapet to take a finishing course in the higher branches. The plan may work, though if Mr. Keess is to have a fair opportunity of doing his part he must have expert assistance.

It seems strange, too, that with the brilliant successes of its extensive schemes before them the members of the Government of Madras should apparently take no thought whatever of the necessity for teaching irrigation. If the ryots' methods are altered in ploughing, sowing, and tending crops, his method of watering must be altered also. The one should depend upon the other, and it is possible that until the processes of irrigation are understood European preceptors may blunder in laying down rules simply for dry farming. Doubtless the ryot in these parts is a clever irrigator, but that is under present conditions; alter them, and he must alter his procedure. One difficulty of course exists, for the white must first learn irrigation before he can teach it. Now that reorganisation is proceeding there is an opportunity to be seized by those entrusted with the direction of agricultural education. Great as has been the success of most of the irrigation schemes, the returns would certainly be greater if, following the ryot into the field, he were taught, through his own blunders and those of his neighbour, how to adapt and develop the practical art of irrigation so as to economise the precious fluid, and increase his all too scanty crop.

No notice of the irrigation of Madras would be complete without reference to the great scheme now in course of construction at the head of the Peryar. This is among the largest and boldest undertakings yet sanctioned in any Presidency, and one whose history is valuable as illustrating the process through which a project must pass in India before receiving final sanction. At the same time it furnishes another instance of the frequency with which the unexpected happens in these great enterprises, and of the courage with which it is essential to face difficulties as they arise. Unlike the Madras works generally, the proposed weir is of great height, situated in the mountains, and commanding an inland area, thus presenting problems more akin to those usually met with in Bombay, and these on a great scale.

The scheme as a whole evinces a thoroughness of consideration which is calculated to impart confidence in its future. It has developed by slow stages and has received the scrutiny of a number of eminent engineers. First conceived at the opening of the present century, it was reported upon in 1808 by the late Sir James (then

Captain) Caldwell, who condemned the project as "decidedly chimerical and unworthy of any further regard." Still there were those who were not deterred by this judgment, and who from time to time more or less examined its prospects and expressed their confidence in them. Sixty years passed before the first detailed plan for the utilisation of the water was prepared by Major Ryves and carefully criticised on behalf of the Public Works Department, first by Major Pennycuick, R.E., and then by Mr. R. Smith. The latter in 1872 presented an amended scheme which, owing to the unfavourable opinion entertained by the Inspector-General of the method of dam construction suggested, was laid aside for six years, though both the officers who had most studied the question defended their proposals. In 1882 Major Pennycuick was instructed to again re-open the matter, and to devote the whole of his time to the fullest examination of all the conditions of the problems presented. He did so, embodying his results in a critical paper, which is admirably brief and perspicuous. The Inspector-General questioned the wisdom of one part of his proposals, and this he amended. On another important calculation of his the opinion of the consulting engineer to the Government of India for State railways was obtained, and here, too, an alteration was effected. An elaborate estimate of the financial returns was obtained from a revenue officer. Colonel Brownlow, the Inspector-General of Irrigation in Madras, finally approved the designs, which were adopted by the Government, and authorised by the Secretary of State in 1884, some twelve years after the earliest draft had appeared. It has seemed well to note this procedure, both because of the impatience often manifested in the colonies if plans for large schemes are not approved and passed in a few weeks after they are first outlined, and because of the light which it throws upon Indian official deliberateness.

Of the necessity for the fullest deliberation in this particular instance there can be no manner of doubt. The project was not only extensive and costly, but of a novelty and boldness which are certain to win for it the interest of engineers. It included the construction of an immense masonry dam, creating a great reservoir by the retention of the waters of a mountain river, and then diverting them through a tunnel from one water shed into another. The Peryar river, taking its rise in the Western Ghants and flowing west through Travancore, has a gathering ground above the selected site of 300 square miles, upon which falls an average of 125 inches of rain per annum. Five-ninths of this fall is expected to reach the stream, and 32,000,000,000 cubic feet to become available during the year. The discharge of the river during certain months exceeds 4,000,000,000 cubic feet. On the eastern watershed, in the plains of Madura, the rainfall only averages 33 inches. Its stream, the Vigay, flowing into the Bay of Bengal, receives a comparatively small portion of this fall, its total discharge during the twelve months amounting to 97,200,000,000 cubic feet, or at this point a little less than the Goulburn. Of this total a considerable share

during freshes passes down to the sea, but the bed is so studded with "anicuts," as weirs are here termed, and with "koramboos," or temporary wing dams of earth and sand, that the whole of the ordinary flow in some seasons is either taken into channels or absorbed. At all times the supply is irregular, and requires to be stored in reservoirs in order to meet the wants of irrigators. The whole country to the east is dotted with tanks, whether for preserving river water as we should require to do on such streams as the Loddon, Avoca, and Wimmera, or for catching and retaining the rainfall. So many of these have in course of time silted up that their shallowness now occasions a loss by evaporation estimated at 30 per cent. As a consequence there has only been 22,000 acres of paddy regularly cultivated in the Madura "taluk," or district; every alternate year brought a scarcity of food, and during the famines of 1876-77 £50,000 had to be spent by the Government within its bounds. While its large population were thus suffering there was in Travancore, on the other side of the range, a plentiful supply of water in the Peryar, pouring down wastefully to the sea, through "an enormous area of uncultivated and uninhabited jungle." It was evident that there was a great work to be done here if these natural conditions could be coped with, and their inequality adjusted by engineering skill and experience.

The task of bridling a mountain river of such dimensions, in an almost inaccessible gorge 3,000 feet above the sea, is by no means to be treated lightly. The first suggestion, for an earthen dam 162 feet high, was soon set aside in favour of the structure of concrete which is now being erected. This superb work was to be 155 feet in height, 150 feet thick at the base, and 12 feet thick at the top, crowned with a parapet five feet in height and four in width. The height has since been increased to 175 feet from the foundation. Its crest length is 1,200 feet, and the whole mass contains 3,600,000 cubic feet of stone. The second plan shows two escapes, one on each side of the dam, with their sills 144 feet above the river bed, giving a total of 900 feet overflow. A ten-feet wall below that on the left provides a water cushion. The maximum level which the storage is expected to attain at flood time is 153 feet. It was at first intended to carry the flow under the dam, during the time of construction, through two immense culverts which were to be afterwards closed by iron doors, but this proposal being condemned, it was determined to allow the escape to take place over part of the dam itself, which should always be kept lower than the main part of the work for that purpose. One culvert, 24 feet square, was approved in order to provide motive power by means of a turbine for engines used in the construction. As the plan stands, the dam is very graceful in outline, and may bear favourable comparison with the great works of French engineers, which have always served as models for this class of work. The difference is that while the material of which theirs are composed is rubble masonry, on the Peryar concrete has been employed instead. In Great Britain earthen dams have hitherto been generally adopted, though not for

great heights. Professional opinion on the Continent is against them, and the successes attained with masonry have of late years induced a strong feeling in favour of the harder material. The position which the Indian work takes among kindred structures is very honourable. Thus comparing it with those in France, we find—

Reservoir.	Height.	Capacity in Cubic Feet.
La Terrasse	146 feet.	130,000,000
Rochetailée	183 feet.	56,000,000
Peryar	175 feet.	13,300,000,000

Of this immense quantity of stored water one-half is available for irrigation.

It is not only as a means of storage, but as a means of diversion, that this design has to be regarded. The first French dam cost almost exactly as much as the Peryar estimate of £93,000, but the total outlay in the Indian Valley is brought up to £275,000 by the purchase of land, and the penetration of the range to carry the water through to the adjoining valley. This is accomplished by a costly cutting above the weir, 5,400 feet long, driven through solid rock, with a width of 21 feet at its bed, which is 113 feet above the river. At this point, where the excavation is 30 feet deep, begins a tunnel 6,650 feet long, with an area of 80 square feet, and a fall of 1 in 75. This leads to another cutting, 160 feet long, conducting the water into the Soorooly. Here there are 13 sluices in a course of 46 miles, in order to convey the new supply put into this stream around existing anicuts used by cultivators. It is then carried another 40 miles, in the channel of the Vigay, before it reaches the weir which makes it available for irrigation. The expectation of its presence here has already led to the construction of large additions to the old works, as well as a new system of distributaries. This begins with a main channel, carried across the drainage of the country, as close to the hills as possible, for 38 miles, with 93 miles of branch channelling along the crests of the ridges, and 102 miles of minor ditches. On the main channel, carrying six feet deep of water, there are 26 inlets and 32 outlets, 2 aqueducts, 3 inverted syphons, 12 bridges, and 13 road tunnels. This channel begins with a capacity of 1,500 cubic feet per second, and diminishes gradually, as the branches take off, to a capacity of 288 cubic feet per second. The whole scheme was to involve an outlay of £650,000, and, owing to accidents, will probably exceed this sum.

In some aspects this great work presents an opportunity for contrast with the most important work yet executed in Australia. The Goulburn river has thrice the discharge of the Peryar, and its weir is a work of river diversion, constructed of concrete, which incidentally provides a storage for 550,000,000 cubic feet of water. The proposed Waranga Reservoir, which is an integral part of the

Goulburn scheme, has a capacity of 9,000,000,000 cubic feet, of which 7,750,000,000 cubic feet could be drawn off and distributed. The channel to the reservoir 24 miles long is 110 feet in minimum bed width, and carries a depth of 7 feet, giving a discharge by Kutter's formula of over 100,000 cubic feet per minute, while that contemplated from the reservoir to the Campaspo would be 60 miles in length, and deliver 50,000 cubic feet per minute. The Peryar dam is nearly three times as high as the Goulburn weir, and more than half as long again, and although it receives the water from a gathering ground only one-thirteenth as large, is even more often flooded. The area commanded by the Peryar is 200,000 acres, of which there will be 100,000 acres watered annually. It will secure two harvests in the year over perhaps half this area, the first of rice and the second of cereals. The Goulburn will command 960,000 acres, and water 320,000 acres once each year, for cereals, vegetables and fruit trees. The estimate of the Peryar scheme is £650,000, as against an estimate of £740,000 for the Goldburn, but the probability is that their final cost will be still nearer. Of course the trust's works are not added in the Australian computation, although the distributaries are partially provided in the Indian scheme. The payment for land in the Travancore monntains amounted to £80,000, while that needed to purchase the rich river flats on the Goulburn submerged by the weir and the reservoir site and channel strip through very valuable farming country will probably exceed £175,000. When it is remembered that labour in India cost but 9d. per day, as against 7s. and 8s. per day in Victoria, it must be admitted that the great undertaking now completed under the able direction of Mr. Stuart Murray sustains the comparison extremely well.

When late in 1888 the base of the Peryar weir was surrounded by temporary protection, and pumped dry, right in the centre of the stream, just where the foundations were to be laid on what was thought to be an even, rocky floor, there was discovered a gaping fissure, 40 feet in length, 23 feet broad, and 20 feet deep. As the site could not be changed it was plain that this chasm must be closed, and consequently it was filled with dry stone, upon which the masonry was built as rapidly as possible. On 1st March, 1889, a night's rain sent the discharge of the river up from 300 to 4,000 feet per second. A temporary dam 30 feet high above the weir was swept down, the fresh masonry, unable to stand the shock, peeled away before the torrent, which then scoured out the dry stone, and thus undid at one stroke all that months of labour had accomplished. Nothing daunted by this reverse, the engineers at once began a coffer dam, supported by masonry piers, 13 feet high and 3 feet thick at the top, placed 6 feet apart, and connected by wooden shutters, strengthened by sand bags and earth. This wall was carried in a line parallel with the stream, from more than 250 feet above the weir, to some distance below, constituting an artifical bank to the channel left open for the river, between it and the opposite natural bank. At the end of 1889 cross dams of earth

were built between wooden piles, 12 feet wide at the top, with a slope of 1 in 4. The front and rear masonry was then put in, and when sufficiently high, the space between it and the main dams was also filled with earth. In December, a freshet carried away almost the whole of the temporary dam above, while the trees which it whirled along battered down two pillars of the coffer dams. The breaches were stopped with sandbags and the work hurried on. In February, 1890, the coffer dam and cross dam were again breached and some of the masonry swept away, and once more, in April, a similar casualty took place; but by the end of the year the core of the dam was protected by masonry walls, so that there seemed every reason to believe that the serious danger was over. When I went northward the foundations were being rapidly put in all over the site, except at the bywash, and by this time should be strong enough to resist even the torrents of Travancore. Engineering skill and European courage, appear to have triumphed decisively in their struggle with natural forces.

It will be at least two years, and possibly three, before this great scheme is in working order; but already a proposal for its extension has been brought under notice. The weir needs no addition, but if the tunnel and channels were widened, could water 30,000 acres more, 10,000 of them twice a year, at an extra cost of £10,000. There are other difficulties nearer at hand. The Madura district suffers, as do many American and Egyptian lands, from the exudation of salt to the surface, if the soil be permitted to remain saturated for any time. Drainage is recognised as one of the chief agents in minimising this evil, and all the branch channels which have been made here are terminated in natural drainage courses. These require to be reviewed before extensions are approved. Another preliminary is financial. The land system exhibits a two-fold proprietary. Out of the area, embraced by the scheme, four-fifths belong to the Government, while the other fifth is in the hands of local proprietors. The first class is rated according to the quality of the soil and the benefit conferred, while in the second it is proposed to deal immediately with the owners. They must be settled with before more work is undertaken. The State derives an indirect benefit from the scheme, the value of which it would be hard to state exactly. As the dry land, utilised for certain inferior crops and purposes, is made to produce a much larger revenue by being brought under irrigation, so other dry land requires to be leased from the Crown in its place, and the receipts from this source are clear gain to the Treasury. The charge for maintenance of the scheme is estimated at 2s. 6d. an acre per annum, and it is anticipated that, when all the water provided is utilised by the cultivators, the direct return to the State upon its investment will be 7¾ per cent. The calculation has been questioned lately, although it seems to have been carefully made. In any case the scheme can allow a large margin for disappointment, and still pay.

There remain one or two points of special interest to Australians

in connection with this project. The first of these relates to the manner in which financial estimates are arrived at in these provinces. The Government being so large a landlord seeks to tax each of its tenants according to his means, and thus divide their inevitable burden fairly among them. For this purpose the land in each district is elaborately classified; every holding being distinguished according to its natural quality, and entered either as black or red loam, black or red or white sand, black or red clay, or as composed of two or more of these soils. A number of experiments were conducted to test the influence of irrigation upon each of them in this very locality. There were 200 tests, applied over 3,800 acres, watered from an anicut channel, in one area; the crop of one-fourth of an acre being reaped, threshed and measured on the spot in each case. Lands supplied by the koramboros, or temporary dams, were examined in this way 340 times, and those watered from rain-fed tanks 467 times. More than 1,000 practical illustrations were thus obtained upon which to determine the assessment of the several grades of soil. The land has to pay for the scheme in any case, but these tests appear to determine the relative contributions in the fairest possible way.

The next point of interest is that an acre when watered for the first time is thought to require nearly six times as much as an acre which has been irrigated for some years. For this American experience had already prepared us. The third point of interest is that, as in Ceylon, ten years is the period fixed upon as necessary before the scheme is expected to be in full working so as to utilise all its water and give fair returns, In the Peryar project the amount of land wetted is set down at 10 per cent. the first season, and an additional 10 per cent. in every after season, until the limit of supply is reached.

The last point which transpires incidentally is the familiar lesson that on the same soils and with the same allowance of water, certain districts always show strikingly superior results to others. The investigations of the officers of the department prove that this is solely due to the difference in the cultivation, that is in the cultivators. The more intelligence is displayed, the more water is economised, and the better the nature of the crops are studied the richer the yield invarably is. Side by side one farmer prospers and another fails, because the first is observant and thoughtful and the second not. Side by side one district flourishes more, and another less, for the same reason. Very much rests with the individual farmer. It is instructive to find that the first lessons one learns from Indian and Sinhalese irrigation, are the same as those which have been repeated to us in every language and every climate where water is applied to the soil. To irrigate successfully, not only is water essential but brains.

CHAPTER III.

THE MADRAS COMPANY'S CANAL.

IT is a curious circumstance that the one white elephant among the Madras schemes was that which was entrusted to a private company. As the study of failures in India is the necessary correlative to a record of its successes it may be advisable to sketch the career of this enterprise with some detail.

Sir Arthur Cotton was a man of large as well as vigorous mind and high professional capacity, but his ability was that of the engineer, and not that of the financier, or of the administrator. He took little account of the character of the people with whom he had to deal, or of purely revenue questions. His eminence in his own profession, therefore, did not prevent him from making serious miscalculations. Having triumphantly restored and improved the Kaveri headworks, so as to greatly enhance their efficiency, and having coped with equal success with the deltaic problems presented by the Godaveri, and the Kistna, he cast about for new worlds to conquer. His faith in the remunerative character of irrigation was built upon the admirable results obtained in these three schemes, and his confidence in his own powers, elevated by the recollection of his recent achievements. In this mood he turned his eyes inland and conceived a project as bold, perhaps, as any ever put forward even in Indian irrigation. An anicut in the Tungabadhra, one of the largest tributaries of the Kistna, was to unite that stream with the Penner, and finally, by means of a canal 200 miles long, with the East Coast Canal, the Kistna delta, the city of Madras and the Bay of Bengal. On the north-west a canal was to proceed from the same centre 600 miles to Poona, and tap the west coast at the fine port of Beitcal, reaching its arms from Ahmednuggur in the far north southward to the coast town of Mangalore. The peninsula would thus be traversed from east to west, and for a considerable distance from north to south, by navigable canals, watering Hyderabad and Raichore. They were to open up 150,000 square miles of country, affect 10,000,000 people, and involve an increased trade of £5,000,000 a year, all for the sum of £2,000,000, one half to be spent on the east, and the other half on the western extension. The mere conception of such a colossal series of works is striking. Their execution would have ranked them next after the Suez Canal among the engineering feats of the century. As it is they have

attained something more like the fame and fate of the Panama cutting.

One recommendation of the gigantic plan was the readiness with which it lent itself to sectional construction. It could be executed piece by piece, so that the experience and revenue gained on one section would assist the completion of the other. The portion proposed to be undertaken at once consisted of four anicuts across the Tungabadhra, a 20 miles canal from the first Koondaur, the irrigation of 250,000 acres from the second, and 120 miles canal from the third to the Kistna, watering another 250,000 acres; another 100 mile main canal down the valley of the Koondaur, river improvements, and a fifty mile canal to the East Coast Canal, the storage of 2,000,000,000 cubic yards of water in tanks to provide a constant supply, an anicut on the Kistna, and 600 miles of river clearing and deepening for navigation. The estimate for this subdivision of the main plan was £1,380,000, showing on paper 27 per cent. gross profit, and 22 per cent. after paying all charges, and without allowing anything for the enormous passenger traffic which was anticipated.

This modified and detailed scheme was certainly tempting enough. Sir Arthur Cotton's reputation was high, and no one appears to have challenged his figures, though a discussion was carried on for some time between the Government of the Presidency, the Government of India and the Secretary of State, whether it was wise to allow so promising an investment to pass out of the hands of the Crown.

The preliminary difficulty as to the collection of rates by a company was easily overcome by an agreement that the Government should accept this task, and pay over the receipts to the company. But the officials of the Presidency argued strenuously that the money for the whole work could be raised by the State more cheaply than by guarantee, which would be certain to induce extravagance and delay, that it would be necessary for the Government to interfere at times when the company would probably resent it, and that the consequences could not fail to be unsatisfactory. The force of these contentions was admitted, but the Secretary of State decided that the introduction of British capital was so important that they must be waived in this instance. The State had other employment for its loan funds, and in face of the doubts of Lord Canning and many officials of high standing, Lord Stanley wrote that "numerous and obvious as are the objections to the employment of private companies in the construction of works of irrigation, the undeniable tardiness, however unavoidable, with which such works have hitherto proceeded in India is considered to leave no alternative, when a private association offers to enter upon an undertaking which promises to add largely to the revenues of the State, and still more largely to the general resources of the people." Accordingly, by a deed dated 3rd June, 1863, five per cent. interest was guaranteed upon £1,000,000, and the necessary land given on condition that the Government exercised a complete control over the

company, received half the profits above five per cent. and retained a right of purchase of all shares after twenty-five years at their average market price for three years preceding. The last form which the scheme took was that of a main canal from the Tungabadhra with three reservoirs of three minor streams, the canal being divided into the Bellary, Soonkesala and Nellore sections. It was to cost something over £1,000,000. No one doubted but that large profits were to be made. The Government was reluctant to lose, the company eager to grasp, them. By 1866 nearly the whole of the £964,000 which constituted its capital had been spent, without nearly finishing the works, but when the Secretary of State offered to purchase them as they stood the shareholders refused to consent. Having their guarantee, they had no need to distress themselves. What the Madras officials had foreseen had come to pass.

In 1866, under a second deed, the Secretary of State agreed to advance £600,000 to the company. This was to be devoted to the second section of the canal; the company was to pay five per cent. upon the sum, with a condition that, if the work was not completed in five years, the Government might purchase the company's rights with its own debentures. It was completed by 1871, but in a manner in which a guaranteed company may carry on its work. Colonel Hugh Cotton, a brother of Sir Arthur Cotton, as chief engineer, furnished an estimate in 1859 for an expenditure of £270,000 giving at the same time a calculation that £102,500 a year would be derived from this outlay. The amount for the Tungabhadra head sluice and lock was set down at £30,300, but after £11,000 had been spent it was discovered, by the completion of detailed surveys, which had not previously been obtained, that the site was impracticable, and consequently it and the sum laid out had to be incontinently abandoned. The substituted anicut at Soonkesala 4,500 feet long, in two sections, connected across an island in the river by an earthen embankment so as to raise the water nine feet, was to cost £12,900. Its height varied from five to twenty-six feet. Owing to bad workmanship and faulty supervision this estimate was found entirely insufficient. The work was breached in 1864, and the crest had to be raised and strengthened by a granite coping in 1865. It suffered again in 1868, and its cost by 1870 had mounted to about £70,000, or more than five times the first estimate. The first section of the canal was put down at £45,000, but the actual cost after the errors of design in slope and revetments had been remedied was £85,000, and has since increased by the addition of provision for drainage and sluices to £112,000. The Hindri aqueduct, rendered essential by the change of site, was to have been of fourteen arches of forty feet span, to be built for £14,500. It cost £30,000, and finally, it being discovered that three of its piers had been built on sand and gravel, a further £1,500 was required. Very little care appears to have been taken in planning the second section of the canal; large sums were spent on works which were then abandoned, while unauthorised substitutions of walls for embankments helped to swell the total from the

estimate of £53,000 to £75,000. The Kadrebagh aqueduct in this part cost 235 per cent. more than the estimate. Owing largely to defective alignment, the canal is carried for miles by walls of many different materials, resting on very poor foundations, which are still a constant source of expense, though gradually being made watertight. The third section of the canal cost 310 per cent. more than its estimate. In the fourth section there was an over measurement of 1,000,000 cubic yards of earth, and so much carelessness that in passing payment the Government felt compelled to state that a better canal could have been built for half the money. It would be tedious to multiply examples of the blunders in this enterprise on the sixth section. The estimate for certain works was £44,000, the cost was £86,000, while a fair price would have been £57,000. The anicut on the Kali was swept away shortly after it was finished, and had to be rebuilt at twice the original cost. It is unnecessary to refer to the many important works on the lower branches of the canal. Some of these have been well constructed, and for little more than the estimate. There were 313 miles of distributaries excavated, commanding 156,000 acres.

The company having spent the Government loan of £600,000, as well as its own capital of £1,000,000, was stopped for lack of funds. It had laid out £368,000 in making preparation for navigation, but had no funds to start it. Mortgage debentures were issued, but only £349,000 was received on five per cent. bonds sold at £82. A claim was then made upon the State for the moneys expended in surveying those portions of the original project which were abandoned for want of funds and want of water. The company's right, in the last respect, only entitled it to draw on the Tungabhadra for seven months of the year, although it might be allowed to take a supply during other months, when the stream was not needed in the Kistna delta; £79,000 was obtained from the Government by this means, and devoted to the purchase of boats. The working expenses for 1880-81 were £1,800, against £573 receipts, and for 1881-82 were £2,215, against £1,498, or a loss of nearly £2,000 in two years. The irrigation proved no better investment, for although the attempts to charge a lump sum per acre without reference to the crops cultivated was abandoned, and a scale substituted fixing rates in the ordinary way, little progress was made. During famine years the Government made large remissions to ryots who had bad crops, at the same time paying full rates to the company on their behalf, but the effort was in vain. In 1876-77 there were 90,000 acres, and in 1877-78, 50,000 acres, irrigated; but in the latter year the receipts only just paid working expenses, while in the former year the returns did not yield one per cent. After this the area supplied dropped to 18,000 acres, showing a deficit on working expenses every year. Although the canal is capable of watering 320,000 acres, and provided with distributaries for 196,000 acres, not ten per cent. of the land that can be irrigated is yet watered. By 1881 a scheme that was to have cost £550,000, had absorbed

£1,240,000, and instead of yielding twenty per cent was being carried on at an absolute loss.

The causes of this utter and lamentable failure are not at all difficult to decipher, and are such as never would be overlooked in India to-day. First the soils commanded were not noted, or it would have been discerned, that the largest and richest part of the district commanded, consisted of black, decomposed trap, which needs irrigation very rarely, is difficult to work when wetted, and bears excellent crops with the average local rainfall. This one circumstance is fatal to large irrigation expectations. Add to this the fact that the residents of these districts had never practised irrigation, were not trained in it, and could grow what for them were fair crops even on their poorer land without its aid in most seasons, and the picture is complete. Ryots in such tracts always grudge the money for water, and rarely ask for it until it is too late to accomplish much good. There is never likely to be any notable return from navigation, for the very simple reason that at present the canal runs from nowhere, to nowhere in particular, and consequently there is nothing and nobody to carry. The extraordinary oversight which led to the unhesitating construction of these great works, without regard to the character of the soil to be watered, of the people who own it, or of the results to be obtained by its execution, is a remarkable incident in the history of Indian irrigation. Even had the works been well and cheaply built, they must have failed. They were not wanted, they are not wanted, and it is very doubtful if they ever will be wanted.

On 1st July, 1882, the State being charged five per cent. guarantee on its million, and having advanced £670,000 for which it received no interest, was compelled to buy out the company for £2,164,000, paying therefore for an isolated fragment of the eastern part of the design as much as was estimated to be the cost of the originally gigantic scheme. Since then most liberal concessions have been offered to farmers to take up waste land under the canals. Free water is given for five years, and in the second five years they are charged only for the land actually irrigated. The minimum rate is fixed at 1s. per acre, and they are offered water for all time afterwards at 2s. an acre per annum. Cultivated lands not watered within the last ten years are allowed water at half price for five years, and at three-quarter price for a second five years. Still the scheme remains barren. In 1888-89, a dry year, the area watered was 35,000 acres, but last year it fell back once more to 22,000 acres, showing a deficit of £99,000 on the year, and a total debit balance of £785,000 on the scheme since it was taken over. As the water rates in Madras amount to 8s. for gravitation, and 6s. for lift water, for average crops, or 4s. and 3s. per acre for what are generally dry crops, it is plain that even cheapness of supply can effect nothing more under this canal.

It would be absurd to lay the blame of this failure in any sense upon private enterprise. What the history of the Madras Company proves in this connection is that it does not pay a Government to

guarantee a private company which constructs public works. Agreements like those made by Victoria and South Australia with Chaffey Brothers, Limited, are undertaken solely at the risk of the shareholders of the firm. The proposed colony at Mulgoa, New South Wales, can cost that colony nothing, but may teach its farmers much. If these enterprises should fail the loss would fall only upon those prepared to risk it. As a matter of fact they all appear to be on the high road to success. Private enterprise of this kind is likely to rival Government works in cheapness of construction and adaptability to particular needs. It merits encouragement on every ground. Nevertheless, the brilliant success of irrigation under State control in Madras is not to be lost sight of. Whether in construction or in administration its works contain much worthy of attentive study. The chief engineer, Mr. G. T. Walsh, is not only a highly trained professional man of great capacity and untiring energy, but an enthusiast who has mastered the subject in all its bearings and branches. He is surrounded with capable assistants, and is thus enabled to present every year an irrigation balance sheet to his Government in which the only blot is the scheme undertaken and executed by private enterprise.

CHAPTER IV.

IRRIGATION IN BOMBAY.

THE Bombay Presidency bears no resemblance whatever in its physical features to either Madras or Lower Bengal. In these Presidencies the cultivation and irrigation are found upon lowlying alluvial lands, where, by means of long low weirs, their waters are diverted, or by means of shallow wells the necessary supply is brought to the surface. The province of Sind, which is under the Governor of Bombay, is a place apart from and having no likeness to the remainder of this territory. Bombay Proper consists of a strip of mountainous coast country, interspersed with high plains and intersected with rivers, whose flats are extremely fertile. The western Ghauts constitute its backbone. It contains a considerable share of the black soil, consisting of decomposed trap, which needs little or no watering. The average rainfall ranges from 25 inches in the Deccan, on the west side of the high level plateau, to 116 inches among the coast hills of Karwar. Famines occur at times throughout the centre and north, so that relief works in the shape of road-making and channel-digging have to be occasionally provided. Its total area with Sind is but 124,000 square miles, or only half as much again as Victoria ; its population and number of villages are only half as many as in Madras. Its cultivated area is considerably larger, but the revenue derived from it only £3,600,000, against £5,130,000 in Madras ; the average rent being 1s. 11d., against 4s. 2d. in the eastern Presidency. This great difference is explained by the fact that there is more irrigation in the Kaveri system than in the whole of Bombay proper, over most of which indeed dry cultivation alone is depended upon. Hence the contrast between its climate and products, as well as configuration, and those of the Presidency already noticed is complete. The differences between the several districts of Bombay are great, but not so striking as to demand special comment.

This Presidency proper has but a small area under irrigation when compared with the rest of India—Sind, on the contrary, has a very extensive area—yet it would not be possible or desirable to pass by its works, which differ considerably in character from those in Madras or Bengal, or to ignore the progressive character of the policy pursued by its Government under somewhat discouraging conditions. A backward step was taken when Mr. C. T. Hughes,

the courteous, able, and experienced head of the Irrigation Department, was required to take command of the whole of the public works of the Presidency as well. Nevertheless, there is no other positive evidence of retrogression. The annual reports, though they deal at length with some schemes which in Madras would be considered too insignificant to mention, are admirably prepared, contain information not included in most blue books, and a set of excellent district maps, on which the schemes are projected in colour upon a fair scale, instead of being dotted about upon one large map. This proves the intelligent interest with which irrigation is being developed and the care with which it is being studied with a view to further advances.

In 1882-83 the area watered by canals amounted only to 28,735 acres, yielding £24,000, while both have steadily risen until in 1889-90 the area was 85,550 acres and the revenue £45,000. The land irrigated from wells, tanks, and other sources in the same year amounted to 145,000 acres. The Agricultural Department, which is perhaps better informed than that of Water Supply as to private works, places the figures higher the year before, giving the area watered by canals as 118,000, and from all other sources, 720,000 acres, making a total of 839,000 acres, or counting twice-cropped fields 933,000 acres, out of 24,500,000 acres cultivated. There is still an ample margin for the increase in irrigation on Government canals, commanding 915,000 acres, of which 533,000 are cultivable and irrigable. Allowing for additional territory coming under works in process of construction, it is certain that this Presidency will ultimately be able to water seven times as much land as at present. The value of the crops irrigated, which in 1889-90 reached £389,000, will be capable of similar multiplication. The wide margin still existing between the acreage actually irrigated and that capable of being irrigated, points to the fact that the Government is well in advance of its people, and has pursued a bold policy in the construction of works.

The governing motive here, as elsewhere, has been the necessity of providing against famine, and indeed £678,000 has been already spent upon schemes which are distinguished as "protective." This is more than one-third of the total outlay upon major works. It is not, therefore, reasonable to include them in the accounts since they were never expected to be reproductive and were not constructed with that end. The total outlay upon larger works has been £1,737,000, which, if the cost of minor and navigation works be added, makes up a capital of £2,428,000 invested in water supply, with a net revenue of £17,533. After deducting the sum spent upon protective works so-called, there still remains another total from minor schemes undertaken with the same object, and even in what are termed productive works there are supplies given gratis and reductions made to public bodies which render the problem of the financial value of the undertakings practically insoluble. The schemes are still in their early stages, water has been given away on new canals; the charges, though recently raised, are capable of

further advance on some systems, and the area to be watered is vastly in excess of that yet yielding revenue. When all these circumstances are taken into account it will be seen that the Bombay Government can fairly claim to be judged by another standard than that of percentages. There is about £15,000 or £20,000 spent each year out of revenue upon minor undertakings, chiefly for irrigation, for which no capital account is kept.

The Bombay schemes are notable rather for the magnitude of their headworks than for their area of supply. There are several worthy of note, and among these may be mentioned the Nira canal. This starts from the Nira River to the south of Poona, and carries its waters for 101 miles due east to the hills near Indapur, with distributaries running southward to the river, which follows a parallel course. The storage lake now in course of construction at Bhatghar already stores 2,000,000,000 cubic feet, and when completed will retain 5,500,000,000 cubic feet, or nearly as much as the Waranga Reservoir. This work will act as a regulator to the river, the water being retained by a masonry weir 127 feet high from its foundation, and 108 feet above the river bed-width five-feet iron gates. Of this 91 feet is already completed. The surface area at full supply will be 3,584 acres, fed from a gathering ground of 128 square miles, with a rainfall of 145 inches. The area commanded only receives 27 inches. There are 107 miles of distributaries already excavated, and 25 miles more sanctioned from the main canal, which is designed to carry 456 cubic feet per second, but is not yet carrying more than 212 cubic feet per second; £591,000 has been already spent, and £46,000 more will reach the estimate. In 1885-86, when water became available, free supply was granted to 11,000 acres. Next year, when charges were imposed, the area watered fell to 4,400 acres. In four years it has climbed to 22,000 acres, though the storage has only been available for one year, and without it no hot weather supply could be guaranteed. The revenue derived did not quite suffice to meet working expenses, but the rates are now raised and larger receipts are anticipated. The lowest ordinary charge is 2s. 6d. per acre for four months' crops, though dry crops are watered during the monsoon for 6d. an acre if necessary; hot weather watering costs 8s., and perennial 16s. per acre. Under these canals the demand for summer and winter was just even in 1889-90. The cultivators in this district exhibit what is styled a "curious cunning caution" in their procedure, which is characteristic of the ryot everywhere. Only a few of the richer and more enterprising have ventured to trust the canals sufficiently to sow small crops for irrigation, and these are regarded by the rest as bold speculators of uncommon courage. The remainder, however, watch results closely, and, when it is perceived that these are good, fall in, season by season, in greater numbers. In 1888-89 there were but 198 acres of "Ground-nut" irrigated; the crop was good, prices were high, and excellent profit was secured. Next year there were 1,134 acres sown, and the return being also satisfactory, no less than half the yield was re-

tained for seed for this year. It is by such steps that the Hindu proceeds, and it is in this manner that it is essential to convince him of the benefits of irrigation, or any other agricultural improvement.

Another great project now in course of execution is that at Gokak, in the collectorate of Belgaum, at the south of the Presidency, near the great falls of that name. There is to be a masonry weir 25 feet high, and a storage at Dhupdal, where the rainfall is 27 inches, capable of containing 1,200,000,000 cubic feet, or one-fifth more than the Yan Yean. So far as this scheme has been carried out at present it irrigates only 16,000 acres, at a total cost of £52,500. The difficulty is that the best part of the land which would be required to increase the size of the reservoir is rich, already under cultivation, and obtains sufficient rainfall to yield excellent crops, while the land to be benefited is dry and poorer. The Hathmati canal, costing £76,000, carrying 191 feet per second for 25 miles, and commanding 28,000 cultivable acres, of which 17,000 are now watered, and the Mhasvad tank, with an earthen dam 3,000 feet long and 80 feet high in the centre, containing 2,633,000,000 cubic feet, built at a cost of £260,000, and commanding 100,000 acres by a canal 28 miles long, which at present waters 7,000 acres, are worthy of note, as are the Khadakvasla and Ekruk storages, which have been already described. The feature of the Bombay works generally, as compared with those in Madras and Bengal, is the far greater height of the weirs and embankments required to divert and preserve water among its hills, and the smallness of the revenue derived in proportion to the area watered. High-priced crops rarely require irrigation, and only low rates can be afforded for the dry crops when they happen to need an artificial supply.

Experiments are conducted on every scheme to test the thirstiness of various crops and the duty of water. These only serve to show how many factors must be united before any certainty on this subject can be arrived at. The soil is not usually analysed, so that large variations must be expected. The season of the year is noted, and marked differences accordingly appear. Under the Ekruk tank wheat required 77,000 cubic feet to the acre, ground-nut more than half, the best rice more than twice, and sugar cane nearly seven times as much. Under the Mhasvad tank wheat required only two-thirds as much as at Ekruk, but ground nut in one instance took double. On the Jamda canal wheat needed almost twice as much as at Ekruk. Under the Ashti tank sugar cane received nearly three times the supply to wheat, and more than three times as much as ground-nuts; while on the Nira canal wheat only needed half as much as the cane. The duty of water one year on the Nira canal was 186 acres per cubic foot per second, while next year it was only 100 acres. Taking the crops by seasons we find the summer duty of water actually utilised begin at 24 acres per cubic foot per second, and rise by steps to 131 acres under the Parsul tank. In winter watering there is the same set of hopeless discrepancies, the Khari cut beginning with a duty of less than three acres per cubic foot per

second, and the Koregaon tank rising to 256 acres for the same quantity. Of 27 returns only two exactly agree, and few are near together. Nothing throwing light upon this important problem can yet be gathered from observations in Bombay. On the equally important question of the quantity of soakage in transit, the figures do substantially support each other. The Panjhra River which works the Hartala, Parsul and Mhasva tanks, and the Jamda canals return their quantities received and utilised at precisely the same figures, while at the other extreme the Hathmati and Palkhed Canals and the Pravara River works confess a loss of 50 per cent. On some schemes the ambiguous answer is returned that all water is utilised save that lost by leakage in the canals. On the Hathmati 50 per cent. is lost in the first ten miles. The probability is that there is a considerable loss from all of them.

The principal products irrigated are the large and spiked millets, which occupy more than a third of the whole area; wheat, which has less than half as much; ground-nut, three-fourths as much as wheat; and sugar cane, half as much. The rice area watered has sunk in this Presidency to half that of sugar cane. The previous year showed an enlargement of the wetted area by 62,000 acres, of which only 11,000 acres was under great canals, so that the departmental figures must always be taken as indicating, but not summing up the totals for the whole country. The fact that the area under fodder was but 1,800 acres, even though increased by 200 acres last year, points to a serious defect in the ryot's system, Gardens and orchards show a reduction of 600 acres in the twelve-month. The remaining crops vary very much according to the year, for the cultivators by no chance purchase water if they think they can do without it. Last season there was a marked advance in the area under maize, though the total was but 2,237 acres altogether. This is a crop which is becoming better appreciated, but is not yet as much planted as it should be in this country.

The Irrigation Act in Bombay exhibits in many of its clauses very visible traces of the kind of Chamber from which it emanated. The Governor has laid down in this Statute, as much for public information as for any other purpose, the conditions under which irrigation is to be conducted in the Presidency, but naturally leaves himself almost as much latitude as he possessed before it was passed. It does not really limit his authority in any way. The wording of the clauses is assuredly comprehensive enough in most cases. Thus the definition of canal may be made to include any part of a river, stream, lake, natural collection of water, or natural drainage channel to which the Governor may be pleased to give that title. This means that at his pleasure streams hitherto belonging and open to the public may at any time be converted into the absolute property of the Department after notice. Obstructions may be removed or a channel closed at the discretion of its officers. They may further enter upon private lands at any time to inspect irrigation, and on an emergency have the most ample authority to take timber or other materials, without permission to meet their needs. Of course

compensation is afterwards paid. The "Governor in Council" decide what crossing places are to be provided. The same body are on all such points the final authority to whom appeal can be made.

At the same time every encouragement is given to private persons to construct channels or other works or obtain the use of them after they have been constructed. When they are prepared to bear the expense they make application to a canal officer, who after due notice to the parties concerned has very large powers of granting such applications. Of course there are clauses under which compensation can be claimed by those conceiving themselves injured. but it is significant that the appeal lies in each case to Government officers, in the first instance to a collector, and afterwards to a commissioner. This is the Indian practice in all cases, but it should be stated at once that the cultivator is in no danger of suffering from the partiality of Government officers to their master, the State. On the contrary, there is always, as has been already remarked, a leaning to the ryot, and as the collector and commissioners are revenue officers they invariably regard the operations of the Irrigation Department with the suspicion of professional men whose clients' interests are being interfered with. Power is formally taken to make abatements and remissions of rates, and it is wisely enacted that a fair share of these shall go to the inferior holders of land as well as to their landlords.

The series of clauses which are directed against the stealing of water are eminently simple and judicious, though the Victorian Legislature has hitherto hesitated to adopt similar safeguards. When water runs upon any land through an illicit breach, all those whose farms are benefited are fined in double rates, and if no land is benefited, and water is allowed to run to waste, then those to whom the channel is carrying a supply are held jointly liable. These general penalties are, of course, only inflicted when no guilty person or persons can be discovered. Those who benefit by means of a percolation through the banks, or whose wells are within 200 yards of a canal, are required to pay for the advantage conferred on them without their request. Summary powers are taken for the recovery of arrears. These enactments may at first sight appear somewhat severe, but a little reflection should show their equity. In scarcely any conceivable cases can they injure the innocent, while they give every ryot a lively interest in the maintenance of the canal and its honest working. This is absolutely essential in India, but is eminently desirable in Australia and everywhere else.

The rules made under the act are framed in the same spirit. Charges are levied according to the crop grown, and if that be mixed, water is charged for on the higher standard. Unless any part of a field not intended to be watered is divided from the remainder which is to be irrigated by a ridge not less that 6 inches high, the whole will be charged for. Though well water is partially employed the whole field is charged unless there is the same kind of demarcation. The remissions are wisely left in the hands of the engineers instead of in those of civil officers of another department, as in Ben-

gal. Finally there is a purely Asiatic authorisation for the employment of the forced labour of a whole neighbourhood when any canal is threatened with serious damage. A list of the men and women capable of work is made out regularly by the collector, and upon summons all must appear to do their share. They are paid for their services according to the highest current rate. Such are the main provisions of the irrigation law, which are valuable as indicating the kind of legislation which experience has shown to be essential to the proper prosecution of irrigation in India. The Panjab Act and that in force in the North-west are practically the same, and need no exposition here.

CHAPTER V.

IRRIGATION IN LOWER BENGAL.

At first sight it would seem that the physical conditions of the province of Bengal—as distinguished from the Presidency of which it forms but a small part—were such as to render irrigation altogether unnecessary. Much of it is naturally inundated each year, and in the remainder wells and rude canals of native construction provide certain security against bad seasons. The rainfall is heavy, and though partaking of the uncertainty common to almost the whole of India, is far more regular than in those great regions in which necessity has driven the people to put forth special efforts in order to obtain an annual watering. As a matter of fact the influence of example, and the ambition to rival successes achieved elsewhere, had a great deal to do with the initiation of the enterprise in Bengal. Having once commenced, the Government have been induced to proceed with schemes because they had been begun, and because its territory too, suffered severely, though only occasionally, from drought and famine. Hence the area watered by artificial means is now considerable, and is steadily expanding. Five years ago the total was 475,000 acres, which has since risen to 560,000, of which no less than 528,000 acres is kharif or summer watered. Counting navigation canals and protective works £7,200,000 has been expended by the Department, of which nearly £6,000,000 has been invested in schemes of which irrigation is a principal object. Three of these, the Sone, Orissa, and Midnapore canals were commenced by a private company, and afterwards adopted by the Government to preserve them from absolute failure. As these together represent £5,750,000 of the £6,000,000, it may be said that the administration of Bengal has drifted into its irrigation development. Taking the returns of the past five years it will be found that at best the works have not yielded one per cent. upon the capital sunk in them. They may be said to pay their working expenses, and nothing more. For some years they have been regarded rather hopelessly, but confidence appears to be regained of late, and there are those sanguine enough to anticipate a time when the enterprise will pay interest. To less sanguine critics it seems probable that the justification for the outlay must be looked for beyond its financial returns.

Of course the chief feature of the province is its river. The

Ganges is sacred at its source, at its mouth, at the junction of its chief tributaries, and, indeed, all along its course. It renders services to the Hindu from the moment it emerges from the hills at Hurdwar until it reaches the sea, carrying upon its bosom tens of thousands of native craft, plying among its innumerable mouths and along its coasts. As a torrent it denudes the hill sides, in its main valley operates as an immense drainage channel, and when at last its fall declines below four inches to the mile, allows the substances which it has carried more than 1,200 miles to settle, and with them has erected a delta more than 300 miles in length. Together with the Brahmaputra and the Meghna it has created a territory, according to Sir William Hunter's estimate, 50,000 square miles in extent, and at least 400 feet in average depth. General Strachey calculates the area formed at 65,000 square miles, and allots many thousands of years to the work. Some millions of acres in the upper portion of the delta are annually refreshed by its waters and their valuable contents, while at the coast they are lost among interminable swamps of mangrove, inhabited only by snakes, tigers and jackals. There are many canals in this neighbourhood, but their objects are drainage and navigation only. There is no need of an artificial water supply. The forces of nature here are too vast and their activity too incessant to permit human co-operation.

A fellow stream plays an almost equal part in the economy of the great delta which is common to both. The Brahmaputra when it bursts through the eastern Himalayas to become an Indian river is thick, turbid, and so heavily charged with silt that everything which arrests its course occasions an immediate deposit. Islets are formed in this way in a single night by means of a fallen tree: every year thousands of acres of new land are created. There is one island 440 miles square which has been made in this fashion. Through alluvial flats built up in this manner the river takes its way, forcing new channels and deserting the old from season to season. That which was the main artery when the English first explored it is now 100 miles distant from the chief of the present outlets. Similar changes are perpetually occurring, but in spite of such vagaries the peasantry utilise the flow to the fullest extent, and year by year in Eastern Bengal obtain from the richly laden inundations the fertilisation of fields which rival in their returns those obtained with patient toil by the fellahin on the banks of the Nile.

Naturally the Bengali irrigation schemes lie beyond the delta, and are confined to Behar, where the Ganges has frequently changed its course, and to the northern parts of the province, where the rainfall, though usually considerable, is irregular. The greatest of them is that which bridles the Sone, one of the larger tributaries of the Ganges, a little before its junction with that river, and distributes its waters on either side by means of canals which terminate in that stream, resembling in its general character the Goulburn project of diversion on each bank down to the Murray. By this means an artificial delta is created without undue risk from the severe floods which occasionally pour across this district. Originally,

the design suggested by the company was much larger than that which the Government has ventured to execute. It was proposed to water 800,000 acres by an expenditure of £2,700,000, which was to earn a revenue equivalent to 8 per cent. After a series of curtailments of the plan, it has only been found possible to supply 300,000 acres for that sum. This figure is not likely to be altered, inasmuch as the river does not promise a greater supply. Reservoirs have been mentioned, but it is highly improbable that any costly additions of this kind will be made to the plan, which has not yet conquered its early difficulties. The errors in the first draught undertaking were due to a misconception of the circumstances of cultivation in Behar. The duty was estimated much too high, and it was assumed that the demand for rabi, or winter water, would equal, if not exceed, that for summer supply. Experience proves that the highest duty obtainable for rice in this locality is little more than half the 133 acres per cubic foot per second expected, while in some divisions it falls to one-third. The duty obtained with winter crops is even smaller, but as 80 per cent. of the farming is rice, which requires watering in summer, and 12 per cent. is sugar cane, which needs a supply both in summer and in winter, the rabi may be left out of calculation. Instead of the demand for water being halved to meet the needs of two seasons the whole of it is concentrated upon one season, and then the water only goes half as far as was calculated upon. Here in a sentence is the reason of the failure of the Sone canals to realise the estimates upon which their construction was authorised. There are contributory difficulties, but these of themselves would suffice to destroy all official anticipations.

There are a few points in regard to the Sone canals which are worthy of notice, and in the first place one which concerns Australia. Of 2,500,000 acres of culturable land, nearly 1,900,000 were under crop before the works were commenced, and of these nearly 900,000 acres were already irrigated, in addition to the regions near the rivers which are annually inundated. The construction of a costly supply in such country is a problem never likely to present itself in Australia, where practically no irrigation exists. The policy so far approved in Victoria, of distributing water to many separated blocks or parts of them instead of concentrating it upon one favoured area, has been much criticised already, and on financial grounds, considered by themselves, it is certainly indefensible. The Government of India has, for similar reasons to those which decided the colony, expressly promulgated the same policy, and has directed that the aim shall be to spread irrigation over as large an area as possible. The object is, of course, in each case to encourage the practice of watering on a small scale, and by a great number of persons, so as to induce a varied culture, and in most parts of India afford a necessary security against famine. It should be remembered, however, that water is far more plentiful there than with us, and that as the channels are extended the greater is the loss by percolation and evaporation, so that this system seriously enhances the capital cost of the whole undertaking. There is also

the absence of that co-operation and association which arise more readily and are more easily enjoyed where cultivators of the same class are collected in one spot instead of being interspersed among estates in which dry farming is practised.

The parental nature of the Government of India is illustrated in connection with the Sone scheme, for not only are remissions made to men who failed to receive a supply at the right time, but also when their crops are damaged by blight or by caterpillars. Although the ryots make every effort to avoid purchasing the water at all, the State, tenderly solicitous for their welfare, takes the risk of a success with their crops, and does not levy upon them in the event of failure. This has to be remembered when the financial results are being examined. If canals are not administered upon commercial principles they cannot be judged by them. A further contrast exists between the Bengal management and that of other presidencies. In the North-West Provinces and Panjab the engineers are supreme, and no remission is made from the water rate levied on the irrigator without their consent, given after an inquiry made to satisfy them that it would be unjust to insist upon payment for water supplied. In Madras, as has been shown, the water rate is collected with the land revenue and as part of it, the cultivator who has once taken the water being taxed to some extent for all time afterwards, whether he uses the water or not. In Bengal, as in the North-West Province, rates for water are struck, but the applications for remissions go to civil instead of professional officers. It is partly to the credit of the revenue collectors that here, as elsewhere, their constant leaning is in favour of the native and rather against the Government, but it exposes the schemes to unreasonable reductions of returns. Less qualified than the engineers practically engaged in supervising the watering, and understanding all its processes thoroughly, the revenue officers exhibit a kindly leniency which occasions much complaint from those responsible for the irrigation. All schemes in Bengal suffer alike from what must be admitted to be a very unwise division of authority. If managed on either the Madras or Panjab plans they would pay much better.

One of the consequences of the liberality of British administration is an encouragement to the natives to prefer groundless complaints against each other and against the Department. The low character of the cultivators of Behar has been already referred to, but it may be taken as an axiom universally applicable that the testimony of Hindus cannot be accepted at all unless well supported by other than oral proofs. There is another obstacle to the satisfactory management of canals which presents itself at every turn. For instance, of the 6,865 complaints received in Bengal in 1889-90, those preferred on the ground of failure of supply are almost wholly false, two-thirds of those asserting a deficient supply were unfounded, and one-half of those protesting against measurements. So sensitive is the Government of its reputation that its officers are compelled to spend a large portion of their time in the refutation of the charges made against their management by persons who have no reputation

whatever. These culminated in 1886-87 in so general an outcry that a committee of inquiry was appointed to examine the working of the Sone canals. The numerous attacks resolved themselves into four counts. It was alleged that certain branches were not needed since the crops required no irrigation. Bhogepur was quoted in illustration, but as the season of inquiry proved dry the number of applications for supply registered from the very men who made the complaints effectually disposed of them. The second complaint related to the red tape procedure of the Department, and some changes were made in order to expedite the transaction of business. The third and fourth asserted that improper assessments were made and deficient supplies given, but evidence was not wanting that so far as these complaints were true it was the natives themselves who were solely responsible. They not only steal when they can, but deceive as much as possible. The strong oppress the weak, take water twice, or out of their turn, damming the channels at night, or cutting the distributaries, while the village channels are imperfectly aligned or neglected, so that it becomes impossible to ensure an effective flow. Beyond some improvements in the method of dealing with demands and complaints nothing was done, because nothing was necessary to be done after the investigation of the committee, which is only alluded to here because of the light it throws upon native character and also because of some of its influences upon irrigation administration.

The works upon the Sone call for no special comment, as they are designed, like those of Orissa, mainly upon Madras lines. The weir by which the diversion is made is 8 feet high, stretching right across the sandy bed of the stream where it is 2 miles broad, and is altogether more than $2\frac{1}{4}$ miles in length. It was intended to provide it with three sets of under sluices, each of 10 bays of 50 feet, and two were built by way of experiment, but one of them, after being much damaged in its piers by floods has had to be lately remodelled and re-constructed. The canals, some of which were excavated as famine relief works, show 218 miles navigable, 148 miles of branches and 1,200 miles of distributaries, commanding 1,728,000 acres to which they carry 5,955 cubic feet per second, capable of watering 476,000 of summer and 540,000 of winter crops in a total of 1,016,000 acres. The area actually irrigated has increased from 268,000 acres in 1886-7 to 305,000 acres in 1889-90, of which more than twice as much is watered in summer as in winter. There are about 1,622 miles of village channels, of which 1,425 miles have been made by the villagers themselves. The rainfall during the last four years has ranged from 40 to 50 inches, averaging 41 inches for the last 20 years. The duty rises from 52 to 78 acres per cubic foot per second, being governed partly by the rainfall and its timeliness. Where canals go wells are discarded, only 3 per cent. of the land in the district being supplied from this source. The navigation receipts bring in less than £6,000 a year, while the water rates give more than £80,000.

It is almost impossible to criticise the Sone Canal upon these or

any other figures that could be supplied, for not only was it constructed as a relief work, but it is still administered with a constant eye to the requirements of the people. The canals, which were commenced in 1870, were not finished even to their present scale until 1880, but in 1873, when but partially completed, the water which they supplied saved 159,000 acres of crops, valued at £500,000. while again in 1888-89, when there was an entire failure of the paddy in the surrounding districts, the canals saved all that was commanded. The rates charged are fixed upon a basis of consideration for the cultivator rather than for the revenue. Thus on the Orissa scheme, under a five years' lease, the charge is only 3s. per acre per annum where the whole irrigable and rice producing area is included : while oilseed, dal and pulses are supplied at 1s. per acre. Those outside these fixed contracts pay twice as much either for rice, cotton, tobacco or oilseed. Sugar cane requiring water for so many months is charged 12s. per acre. These are the rates when the supply is given by gravitation, but if the owner has lands above the level of the distributary to which he is obliged to raise the water by mechanical means, a rebate of one-third is made in each case. On the Sone canals the charged is 6s. an acre for rice and 5s. for winter crops on annual leases, while five year leases are charged 4s. per acre for all crops. From April to June, in the hottest weather, the rate is 8s. an acre. After this comes the list of remissions, in which one finds 15 contingencies under which reductions are made to the farmers, while there are four or five further sets of circumstances under which sums are written off. The final result, however unsatisfactory to the Treasury, ought not to be by any means unsatisfactory to the ryot. From his point of view the scheme should be considered an unqualified success. and the Government is evidently content to let this suffice.

The remaining canals are not important enough to demand detailed consideration. The Midnapore which, in the first instance. formed part of the Orissa scheme, represents a capital outlay of £828,000, but here navigation is the main interest, the receipts from its 53 miles being £14,816, as against £11,649 from irrigation. The Hidgellee Tidal Canal, which cost £184,000 for its 29 miles. returns £4,000 a year for boat tolls, and practically nothing from any other source. The Calcutta and eastern canals, in which over £500,000 has been invested, bring in £48,000 a year in the same manner from the 148,000 boats plying through them. Upon these last, powerful steam dredges are always at work in order to keep the channels clear, and silt removal forms a formidable item on some irrigation canals as well. For instance, more than 10.000,000 cubic feet a year is raised from the Sone system at a cost ranging from 4s. to 12s. 6d, per 1,000 cubic feet. according to the height of the spoil bank, beyond which it is deposited, or the manner in which it is barged either to the river or to a suitable landing from the canal. Twelve Fernacres, two Bruces, and two English dredges were at work in 1889-90, as well as a number of mud punts. The Fernacres were considered decidedly the best machines. When raised by hand.

the silt cost 10s. 3d. per 1,000 cubic feet. Two or three hundred pounds a year is spent upon weed clearing, while repairs, which may be set down as maintenance, vary from but a few pounds to £1,000 per mile of the chief canals, according to tho severity of the floods or the rainfall and other circumstances of the year. In such a climate the constant attention and constant expenditure everywhere essential, are even more requisite than is the case elsewhere for the preservation of important works.

At about the middle of the present century Sir Arthur Cotton was at the summit of his fame as an hydraulic engineer. He had gained the confidence of men high in office and of the public by the success which had attended the execution of his projects in Madras, and had not yet learned the lesson of warning afterwards taught by the Madras Company's canal. Flushed with triumph he was called upon to deal with another delta closely resembling those in which he had accomplished so much in the south. After a careful examination of the Mahanadi, he presented a report dealing with that river and its neighbours, and developing a scheme upon a great scale for the irrigation and navigation of an immense area from Cuttack and its coasts to Calcutta. There was, so to speak, a "boom" in irrigation just then, and though the Government would not directly face the outlay required, it agreed to assist any private company that would carry it out. Sir Arthur Cotton had himself made the suggestion, and a company was formed in 1860, incorporated by act of Parliament in 1861, with a capital of £2,000,000, and power to increase this if necessary, which was to construct the works and distribute the water, while the Government on its part agreed to give land and collect rates for the company. The Madras Irrigation Company had been ambitious of adding this undertaking to that in which they were already engaged, and were chagrined at the refusal of the Secretary of State to permit this increase of their responsibilities. Never were schemes launched under better auspices, with more confidence on the part of those concerned or under the shelter of greater names. The largeness and boldness of the design, like that of the Madras Company's works, were such as to naturally commend it to the adventurous and ambitious and appeared to offer every assurance of success.

The province of Orissa lies to the south-west of Calcutta, having within its 23,000 square miles a population of 4,250,000. A narrow line of sandy hummocks along the coast covers a marshy stretch of mangrove and jungle, shielding deltaic land in process of formation, as at the mouth of the Ganges. Beyond this, where it has been consolidated and cleared, lies a belt of plain 200 miles in length and from 15 to 50 miles broad, devoted to tho cultivation of rice, maintaining 3,000,000 people on a little more than 3,000,000 acres. Beyond this, the uplands rise through hills to the border of the eastern plateau, from whence seven rivers debouch on the lower lands. The greatest of these, the Mahanadi, has a catchment of 48,200 square miles, pouring through a gorge at Naraje three-quarters of a mile in width, and rising in flood nearly 30 feet above its summer level. Its slope

above is over 3 feet, and below declines from 2 feet to about 9 inches per mile, with a high flood discharge of 1,570,000 cubic feet per second, which in the dry season dwindles at times to as little as 500 cubic feet per second. Its neighbour, the Brahmini, varies between 600,000 and 150 cubic feet per second. The Byturni caught in a natural reservoir spills one half as much in flood, and falls to half the dry weather volume of the Brahmini. The remaining four rivers yield smaller volumes, though their united flow in heavy rains makes up an immense total.

From the early years of the century the Government on a random plan, but in a regular way, continued to erect embankments for the protection of the plains. The more these were extended inland, the higher they had to be raised below, and at last it was estimated that over 1,200 miles had been constructed. The country therefore assumed a Dutch appearance, areas of cultivation lying below the water level along all the streams. The average rainfall of the province is from 55 to 65 inches, and it is, for India, regular in its recurrence, though at times it fails altogether, when the crops most need it. At other seasons it nearly doubles the average, and 10 times in 20 years occasioned floods which in five instances worked great disaster. The means of communication formerly available were of the poorest, the hills to the north being practically inaccessible, the coast affording no protected anchorage, and the rivers being extremely difficult to navigate. Wheeled traffic was little known, and in wet years even pack bullocks could not be used. As a commission described Orissa, the people, shut in between pathless jungles and impracticable seas, and alternately visited by flood and drought, were always liable to terrible visitations of famine.

There was assuredly every need for the employment of artifical means to mitigate these constant dangers occurring in a productive country, and at the very gates of the great rice fields of the peninsula. The works, planned according to the design of Sir Arthur Cotton by Colonel Rundell, appeared worthy of and sufficient for their task. It was proposed to grapple, not only with the seven rivers of Orissa, but with two beyond, to embank and regulate them by weirs and reservoirs so as to prevent inundation, provide for navigation between Cuttack and Calcutta, and the irrigation, by means of some hundreds of miles of main canals and distributaries, of 1,500,000 acres, with a possible extension to 2,250,000 acres. The headworks were of the same character as those which Sir Arthur Cotton had built in Madras. They rested upon wells sunk 5 or 6 feet below the bed of the river, were from 500 yards to a mile and a quarter in length, did not exceed 12 to 15 feet in height, were furnished with gates in the same manner, and built of masonry protected by rubble, or in parts of rubble only. There is nothing in them calling for special description, as the type is well known, and has already been noticed. One point, however, is of capital importance in both senses of the word. The estimate of Colonel Rundall was originally £2,000,000 for the watering of 1,500,000 acres. After a time the directors of the company, while anticipating a profit of from 9 per cent. to 21 per

cent. according to the scale on which the works were pursued, raised the estimate to £3.000,000. Between 1863, when they commenced tho works, and 1869, when the Government, which had been obliged to make advances towards their prosecution, finally took them over, nearly £1,200,000 was laid out upon them, and since then, although the Midnapore canal is dealt with separately, and the main channels have been left unsupplied with distributaries, the capital cost has mounted up to £2,388,000 for only a fragment of even the amended scheme. Completed on the original scale, it would probably have cost £6,000,000. It is unnecessary for us to inquire under what circumstances the Government of India was induced to take over this scheme just as its costliness and failure were demonstrated, and upon terms so favourable to the shareholders. The Irrigation Department of Bengal appears to be blameless in the matter, for it neither suggested nor approved the bargain.

The results actually obtained from irrigation on the canals fell very far short of the estimates, and very far short of the capacity of even the incomplete works. In 1866, though there was water for 60.000 acres available, only 6,674 were actually supplied. In 1867, with water for 153,000 acres at hand, less than one-fifteenth of it took a supply. From thenceforward sales were effected only in seasons of drought, the natives preferring to run the risk of losing their crops altogether rather than purchase a supply before the very last moment. Often when purchased it came too late; the paddy was past revival, and the land so dry as to permit neither of rapid nor of effective watering. In 1872 less than 5,000 acres were wetted. Rates had been reduced by the company in vain, and concessions were made by the Government as unsuccessfully. Under such circumstances it is perhaps not surprising that the State refused to spend a rupee upon the construction of distributaries, in spite of the representations of the officers that by those means the people could be tempted to utilise the water more freely.

This, then, is the story of the great Orissa irrigation failure, which for so long a time paralysed all developments of water supply in Bengal. The scheme was a success, accomplishing practically all that it promised; water was made available for irrigation; floods were reduced and navigation was rendered possible. The works stood the strain imposed upon them until 1886, when two of them were seriously damaged by floods. On the whole they have fulfilled the purposes for which they were constructed. There was no failure therefore on the part of the engineers, unless, indeed, turning to the finances, we note that the cost proved to be twice as much as was originally estimated. For this, tho universal ambition of engineers to preside over massive and handsome masonry headworks, is in some measure responsible. These, although built for a private company, were doubtless more expensively constructed than would now be thought essential, and the necessity for coping with floods much greater than those of the south, added considerably to the capital outlay. Labour, too, is dearer in Orissa than on the Godaveri or Kaveri. These increases ought to have been foreseen, no doubt,

when the Madras experience was adopted as a guide, and the projectors are certainly censurable for having omitted them from their first calculations. There was a grossly insufficient estimate, and some extravagance in construction. Here begins and ends the engineering part of the failure in Orissa.

Errors of this description are common to most engineering enterprises, until accumulated instances of miscalculation warn the officers of their risk, and acquaint them with the sources of extra expenditure. They were not too serious to be overcome but for their combination with other errors of a much more serious character. The chief cause of the continued failure now is the absence of any demand for the water on the part of the cultivators. The greatest difference between the delta of the Mahanadi and that of the Godaveri lay in the rainfall, which in the former was sixty inches as against thirty six to forty inches only in the south. This difference had been altogether ignored. It is true that a certain supply could be profitably utilised, even with such a rainfall, were the ryots sufficiently enterprising to inaugurate a new system of culture. But the obstacles to this, always considerable anywhere, were unusually operative in Orissa, where the land tenure, like that of other parts of Bengal, placed the peasant at the mercy of the Zamindar. This was the second serious omission of the projectors. They should have recollected that, while subject to these landlords, every fresh exertion of the tenant, or every improvement occasioned by his economy or industry, would only furnish further inducements to his proprietor to multiply demands upon him. Whatever profits might be obtaiuablo by irrigation would go to the absentee Zamindar, while the labour and the loss would fall upon the ryot alone. The cultivators of Orissa, though many of them of the Brahmau class, were noted even among Hindus for their ignorance, dulness and lack of energy. Their inertness may to a large extent be traced to the land system which the Government had been unwise enough to establish, and the disastrous results of which are now made manifest here and elsewhere. To have spent large sums upon an irrigation scheme in a country with a considerable rainfall, and held under a tenure discouraging all improvement, was palpably a blunder —an unpardonable blunder from a financial standpoint reflecting strongly upon the intelligence of those responsible for it.

As it happens, however, there is another point of view from which this investment can be regarded, and from which the scheme assumes another aspect. Subject to frequent floods, to occasional droughts and to the interruption of its communications, the district was formerly always on the verge of famine. When any of these catastrophes did occur the density of the population rendered them terribly disastrous. The floods in one district in one season destroyed crops valued at £1,000,000. The famine of 1865-66 cost the lives of 1,000,000 people, and the Government £1,500,000 to save the remainder. During a period of thirty-six years the remissions made by the State amounted to nearly a twelfth of all the revenue received. Prior to these works the whole province

depended upon one crop in the year; if this failed from excess or deficiency of moisture, all failed, and there was nothing but starvation before the people. To-day there are 250,000 acres commanded upon which one crop can be saved, or upon which another can be raised in its stead, 375,000 acres are protected from floods, and there are 177 miles of canal by means of which produce can be transported to any region of dearth. If the fifth canal were locked like the other four, this would be much increased. Thus, after all, a permanent protection has been afforded at no greater cost than would be spent in two years in the spasmodic effort to save life and mitigate disaster. If the works had been undertaken with this end alone they would be pronounced successful. In such an aspect they have fully justified their existence. The failure has been in theory and in prophecy, and the success in fact.

It is not yet clear that the works may not become fairly remunerative, even for irrigation purposes. In the reaction of despair to which the Government was for some time subject, all extensions of every kind were peremptorily refused. In consequence the works to-day are not fairly judged, since although only 250,000 acres can be actually supplied there are 511,000 acres commanded and only waiting for distributaries. Their development has been proceeding tardily for seven years, but the Lieutenant-Governor within the last month or two has publicly announced his intention of hastening their completion. There is good ground for this, not only to afford further security against seasons of scarcity, but also on the evidence afforded that the ryots, though slowly, are beginning to realise the value of the water and to utilise it. They are stimulated to this by legislation protecting tenants, and, perhaps, by the approach of a new revenue settlement; but they are also learning the profits from summer crops which they are enabled to raise. The growth of the area irrigated has not been regular, though it rose from about 20,000 acres in 1857 to 133,000 acres in 1882-83. Next year it fell to 48,000 acres, from which it has steadily climbed to 186,000 acres for 1889-90. Of this total, no less than 180,000 acres took a kharif, or summer watering. That this result was not due to the exigencies of the season is clear, from the fact that the rainfall was nearly sixty-eight inches, and considerably heavier than for any of the five preceding years. When the 764 miles of distributaries have received the authorised additions, there will be 600,000 acres capable of being supplied each year, and though this will add another million to the cost of the scheme, there is reason to anticipate that, even financially, it will be found to be money well spent. The returns for last year show a revenue of £30,000, of which £20,000 was derived from irrigation. After the new settlement, and allowing for an equal growth in the future, it is possible that instead of being worked at a dead loss as during past years these works may yield one or two per cent. upon their capital. The balance will require to be written off as famine insurance, and a very cursory examination of the records would convince any impartial critic that it is the cheapest form of insurance available.

The great railway, from Madras to Calcutta, now authorised must eventually intersect this district and thus afford an additional means of food importation and exportation. But it must always be profitable to the Government to encourage each province to maintain itself upon its own soil, by the labour of its own people, rather than have many of them upon its hands as paupers who require to be supported in bad seasons upon a suplus bought in prosperous parts and conveyed to them by railway or canal. Taking into account the circumstances of India and the character of its people, the Orissa canals cannot be denominated failures, though constructed with a view to the profit of private persons, and now being finished at the public expense as a means of preserving life. To Caucasian countries they should serve as a standing illustration of the imperativeness of weighing irrigation proposals in other scales as well as those of the engineer. Physically possible they may be, brilliant exhibitions of engineering skill as well, and capable of doing much service when utilised; but if for economic or other reasons the farmers are not disposed to take advantage of them, their construction from the public funds cannot be justified, unless indeed it should be in a country like Orissa, in which the State derives its revenues from the soil, and in which the failure of a harvest may mean the loss of hundreds of thousands of lives. As such conditions are not conceivable in Australia such enterprises need not be encouraged.

It is at least curious that the failures of irrigation, such as they are both in Madras and Bengal, should have been inaugurated by private enterprise. Those who condemn State investments for the purpose of watering State or private lands may note with advantage that it is not only Ministries and Legislatures which are sanguine in their forecasts, but that private persons have risked their capital and great engineers their reputations in ventures, which on the success achieved fall far below the average of those which the State has itself undertaken in India. It is evident that the cautious criticism of public officers may be made as searching as that of private professional men and financiers. Besides, the State has other objects in view than profit and can afford to wait for good returns, so that it be plain that its resources are being steadily developed. The negative conclusions to be drawn from Indian failures are therefore in no sense unfavourable either to irrigation or to State action.

The causes of failure on the Orissa and Madras Company's schemes are just those which might occur in a Caucasian community, for if the sites of canals be badly chosen, the estimates unreliable, and the people unenterprising, the same failure would follow in America or Australia. These misadventures are, therefore, full of interest to us, and their lessons should be well laid to heart. The same principles as were in operation in them are true all the world over, though particular events, of course, will never be exactly parallel. There is an entire contrast between the crops and cultivation of Madras and Bengal and those of the parts of Australia which lie in the temperate zone. Practically nothing that is grown there is grown here, and all the circumstances of production and change are diverse.

Of course if any farmers do not need water they will not buy it, and will sometimes prefer a smaller crop and the risk of losing it to a greater expenditure in order to obtain a certainty. Rates of interest. price of labour, and facilities of exchange, have also to be taken into account. Irrigation, alike in most of its practices all the world over from France or Italy to Victoria, and from Mexico to Japan, has to be considered with the social and industrial system of its country, to which it is subordinate, and which in India is entirely opposite to our own.

No summary of the position of irrigation in Bengal is possible which would have any bearing upon the situation in Australia; nor can its schemes be judged by their returns. The value of the crops irrigated amounts to about £1,750,000 a year. But the produce in a time of dearth is worth many times as much to the Government, which feels bound to step in and spend money lavishly rather than permit its people to perish by starvation. Catastrophes occur with depressing frequency. In course of time rivers change their course or silt up their beds, a slight alteration often sufficing to throw out of gear the whole of the rude arrangements which had been made by the ryots for watering their fields, and upon which they have depended for two or three generations. The sand from the dry course of the stream blows upon their cultivation and impairs it. while a heavy fall of rain produces floods which carry devastation far and wide. In every adverse contingency the State pays. In Behar, sugar cane, potatoes, onions and other important crops cannot be grown at all without irrigation, even in fertile parts, and yet the landlords will do nothing themselves, nor encourage their tenants to do anything to promote the indispensable water supply. Until it is prepared to take legislative means to compel the Zamindars to do their duty, there appears to be no other resource for the Government than to play the part of providence, as it does at present, hoping all things, believing all things, enduring all things, rather than see the hapless people committed to its charge sacrificed either to their own thoughtlessness or to the greed of those who have been allowed to seize the soil

Considerations of this kind pertain peculiarly to British India. While they rule, irrigation must remain the most benevolent form of public works in the province of Bengal. But it would be unjust to the engineers who devised the schemes, and to the officers who control them, to attempt to judge them from a financial standpoint only. A Government is entitled to choose its own end and devote its administrative authority to its attainment. The end in view in establishing irrigation in Bengal has not been to make a profit nor even to earn interest upon the capital invested, except in a secondary way. The schemes are, at all events, now maintained as a means of protection against famine; rates are fixed and remissions made with that object, and not with an eye to any gain or even question of value. It would be difficult, and might be impossible, to make these works pay; but as the Government does not attempt to do so, but, on the other hand, definitely and persistently subordinates all

idea of profit to its beneficent intentions, it follows, of course, that the schemes can only be tried by that standard.

The history of a failure of irrigation works in India is worthy of careful study, because failures are rare and because it is highly desirable to utilise such experiences so as to be able to avoid their repetition elsewhere. The ripest knowledge and the greatest ability are alike vain when it is sought to justify works in one situation merely because they have been successful in another. Nature is not to be imposed upon by the highest reputation or the most venerated precedents, and soon asserts her independence in defiance of the sanctions of all the departments, and even the imprimatur of a Secretary of State.

CHAPTER VI.

IRRIGATION IN THE NORTH-WEST PROVINCES.

In contrast to the work of the province of Lower Bengal, though forming part of the same Presidency, the North-West Provinces exhibit a far higher development of irrigation to-day, and something like a historic sequence in its growth in the past. The early history of the oldest canals is involved in obscurity, but we have abundant evidence that their value was realised 700 or 800 years ago. Feroze Tughlak constructed one in the middle of the fourteenth century, and the records of his reign declare that he built 50 river dams and 30 reservoirs for irrigation, as well as 100 public baths, 150 bridges, 100 hospitals, 40 mosques and 30 colleges, "besides many other edifices for pleasure or ornament." The Emperor Akbar orders in one of his decrees that "On both sides of the canal down to Hissar, trees both for shade and blossom be planted, so as to make it like the canal in Paradise, and that the sweet flavour of the rare fruits may reach the mouth of everyone." The remodelling of the Western Jumna Canal is due to this monarch, whose grandson, Shah Jehan, in his turn, extended the system, building the Delhi canal, with Ali Murdan Khan as his adviser, and receiving a lesson in hydraulic engineering which he was not soon able to forget. The first line was laid out so erroneously and with such weak embankments that the water burst away, committing fearful devastation, and totally destroying the town of Lalpur. Probably the head of Ali Murdan sat uneasily upon his shoulders until he was permitted to alter the route of the canal by constructing an aqueduct and making a rock cutting 60 feet deep in place of the defective embankment. Fortunately for him this proved sufficient for its end, and the scheme worked successfully from 1626 to 1753. Ali Murdan was evidently not a signal success as Chief Engineer, for the Eastern Jumna Canal, another work of his, failed altogether soon after it was constructed, and though reopened in 1780, was again rendered unserviceable by floods. Notwithstanding these disasters canal irrigation was practised in this territory most satisfactorily for nearly 400 years, in spite of the universal tendency of the people to let the works fall into disrepair. But with the breaking up of the Mughal Empire in the middle of the eighteenth century, the reckless ravages of war were added to the processes of natural decay by neglect, and the whole system was abandoned.

Little information has survived to us of the methods of irrigation in vogue in those times, though the conservative character of the population renders it more than probable that there is but little difference between their practices to-day and those which then obtained. Excellent mathematicians as many of the Muhammedans were, their practical engineering appears to have been carried out, if we may judge them by their contours and alignments merely, by rule of thumb, and certainly without any very nice proportion of means to ends. There was the same handsome solidity about their masonry, whether upon a distributary or upon the main canal, while the fact that they worked for an imperial master left them less eager for economies, and less careful of the rights of private owners, than would have been possible in Europe. Defective drainage was a common fault, and the creation of swamps below the canal banks a comparatively familiar feature. The general outlines of their schemes however, were chosen with care, and laid down with ability. Apparently they understood what ought to be done, even if not careful in realising the design in actual execution.

They certainly knew what irrigation ought to be, especially for the gardens, which still flourish in their ancient palaces. Some of the Arabian Nights' Tales were recovered from Bengal, and it would be impossible to devise a better plan of irrigation than that described in the story of the third calendar. "This delicious orchard was watered in a very particular manner. There were artificial channels so proportionately dug that they carried water in considerable quantities to the roots of such trees as required much moisture. Others conveyed it in smaller quantities to those whose fruits were already formed; some carried still less to those whose fruits were swelling, and others carried only so much as was just requisite to water those which only wanted to be ripened. Lastly, those channels that watered the trees whose fruit was ripe had no more moisture than just what could preserve them from withering." Whoever wrote this romance was certainly proficient in practical irrigation, and doubtless helped to impart it by this means to the eager crowds, who to this day hang upon the lips of the storyteller in a quiet corner of the bazaar.

The establishment of British supremacy in the North-West Provinces led naturally to attempts to improve the condition of the people, and the first efforts were directed to the restoration of the old irrigation system. The Western Jumna Canal, now included among the Panjab systems, was repaired and reopened in 1820, that of Feroze was taken in hand three years later, while the Eastern Jumna Canal was put in working order in 1830. This last was a notable undertaking, since it depended upon embankments 30 to 40 miles in length, by which the water was held from 6 feet to 12 feet above the level of the surrounding country. The mistakes in the alignment of the Western Jumna were at once apparent upon its being brought into use, and here and elsewhere the engineers had the exceptionally difficult task of correcting errors in the original work as opportunity offered. By 1833-34, however, the canals were beginning to

cover their expenses, which, of course, included only repairs and alterations, and in 1837-38, a season of great dearth in this province, it was calculated that two of them had saved £2,000,000 worth of crop. In 1889-90 these canals had returned to the Government the interest upon their capital expended since 1830 and over £100,000 besides. Further than this, the experience gained in connection with the old Mughal works was of the highest value in training the English engineers associated with them. Just as in Madras the practical way of dealing with a deltaic river near its mouth was suggested by ancient native structures, so in the north-west the idea of grappling with a stream nearer its source and diverting it upon the arid plains below was rendered familiar by Muhammadan experiments. This province became the seat of a new school of irrigation engineering, whose triumphs, altogether distinct from those in the south, have steadily extended its sway over the whole of Northern India.

Even the Independent States of Central India and Rajputana have taken pattern by these achievements. Lalpur has proved itsself, as usually, especially enterprising. Its expenditure on irrigation up to the end of 1888-89 amounted to £316,000, from which a revenue of £31,000 a year was being obtained. There are 108 separate works, irrigating 76,000 acres by 364 miles of main channels and 422 miles of distributaries. Five large storages have been built, of which that at Tori is 6⅓ square miles in surface. Projects for reservoirs on the Banganga River, and on the Banas, are under consideration, and a proposed outlay of £231,000 for these and other extensions is before the State Department at the present time.

Under British influence, and by the aid of British engineers, a great deal of valuable work has been done, not only in the little patch of Ajmere under its direct control, but in the States around. Upwards of 300 tanks are now in operation, some of them restorations of old storages, many of them new, representing altogether a capital of over £150,000, providing the irrigation of nearly 30,000 acres, and an income of about 4 per cent. after the payment of working expenses. These tanks are being steadily multiplied, until already in some districts the natural advantages appears to have been taken advantage of to the fullest extent, and the whole of the rainfall which can be caught is now utilised. Although native management is defective, it has one recommendation to the cultivators, since there is not the same energetic effort to make the investment pay its interest which is exhibited in the British domain. All the schemes are not small; Kotah has a canal 180 miles in length, but as a rule these undertakings are on a very small scale as compared with those in the Presidencies. In the great southern principalities irrigation takes another form, and is especially developed in Mysore, where there are nearly 1,000 miles of canal and upwards of 20,000 tanks, some of which have dams over a mile in length. The greater proportion of the watering in Upper India is accomplished by less imposing means. There are thousands of rain-fed

tanks scattered over its plains, from each of which a handful of husbandmen draw a precarious supply. There are also small diversions and storages from intermittent streams. Where these have been constructed with State funds, the ryots for whom they were built are required to pay a fixed assessment year by year. Remissions are made to them in exceptional seasons, but with less liberality than in the British dominions. The climate and physical conditions of this region closely resemble those of Central Australia. Patches of cultivation occur in the long level wastes, well grassed in good seasons; yellow, dry, and swept by storms of gritty dust in summer; barren and bleak in bad years to such an extent as to drive their population and their stock to the nearest spots where food and water can be obtained. These harsh nomadic experiences have reared a hardy and fearless race, who regret the days when, with their Maratha kindred, they could spend the dry seasons in raid and foray, pillaging the softer peoples of more favoured tracts, returning with their booty and settling down peacefully when propitious seasons permitted them to become again the simple tillers of the soil.

A bird's-eye view of the modern systems in the North-West Provinces will include many of the most important in India, but will not then embrace by any means all the area regularly watered. The populous and prosperous district of Oudh enjoys a rainfall sufficient in most years to mature its crops, annual inundations near some of its streams and many natural storages, so that, with its wells, it obtains a considerable amount of watering from what may be termed private sources of supply. The tract in which the great State canals are is known as the Doab, or two rivers, because it lies between the Ganges and its great tributary, the Jumna, which, leaving the Himalayas less than 40 miles apart, flow between 400 and 500 miles parallel to each other, enclosing a long level strip containing more than 20,000 square miles of country of good agricultural quality. Each of the two greatest of the canals, taken from and named after the Ganges, may be ranked among the chief irrigation works of the world, and if regarded together as composing one whole, they certainly constitute the largest and most perfect system of the kind. They have already been described at some length, though then only in a superficial way.

The Doab, though chiefly watered from the Ganges, has also on its lower edge two canals of considerable size; one of them ancient, and still extremely remunerative. This is known as the Eastern Jumna canal, which commences close to the hills at Raipur and flows south-eastward, following the same line as the river from which it derives its supply, but taking a shorter and more direct route. It falls into the Jumna again at Delhi, from whence it may be said to start again under another name, and is prolonged, still in a line with its river, as far as Agra. These two canals, hugging the eastern bank of the Jumna, leave by far the greater part of the Doab to the wonderful network of channels from the two Ganges canals, which interlace along its plains like veins on the back of the

hand. At right angles to them, and following another slope, is the new Betwa canal, beginning near Jhansi and flowing down to the west bank of the Jumna. Two schemes, similar in character and direction, are projected from the Dassan and the Ken further south. but the only others worthy of note in existence to-day are two small groups, one on the mountain sides above and between the head-works of the Ganges and Jumna canals, and the other away to the east on the southern side of Naini Tal. At present, therefore, the map of the North-west Provinces presents a decided contrast—a belt of country running from north-west to south-east, gridironed with channels, and a great space half surrounded by this belt, in which there is not a single Government canal, though there is a great deal of private irrigation. When the need arises, and when funds are available, this difference will disappear, for a project has been roughly outlined by which a great canal from the Sarda, near Kataiya, would sweep through the space in question, throwing out immense arms which would embrace the whole of this country from near Shahjehanpur by Allahabad to Benares and Azamgarh, its centre line passing through Lucknow to Caunpur. This gigantic proposal, involving hundreds of miles of canal, and an outlay of some millions sterling, remains nebulous at present, but if ever executed will leave only Rohilkhand and Eastern Oudh unsupplied by canals in the whole of this magnificent province.

When the Eastern Jumna Canal was first constructed by the English, irrigation engineering was in its infancy, and before it had been open for three weeks the excessive fall in its bed had created a series of rapids which threatened in their working back to engulf the bridges. Nineteen masonry drops were introduced, and the embankments, which frequently burst, with immense damage, were strengthened until they possessed sufficient stability to endure the strain. In 1854 the soakage from the canal and stoppage of the natural drainage by its embankments having created extensive swamps of a malarious character, fresh cuts were introduced, which have been supplemented in 1876, and since then from time to time, until at last this difficulty has been almost wholly removed. Quite recently it has been necessary to direct the river course by means of masonry spurs, and introduce aqueducts upon some of the distributaries. At the time of its construction the problem was how to carry the canal for its first few miles across the drainage lines of the country. Four torrents had to be faced in its first section, and though it was possible to divert the greater volume of their floods, provision had to be made either for passing sudden bursts of rain water beneath its course or in taking part of them into the canal itself. Quite recently a new escape channel has been excavated at Raipur, furnished with a concrete and masonry regulator and overflow.

The Jumna itself, although a tributary, is a river of no mean dimensions, having a length of 860 miles and a catchment area of 118,000 square miles. Taking its rise in the Himalayas, nearly 11,000 feet above the sea level, running for more than 100 miles as

a mountain stream, it leaps from rocky rifts into steep valleys with such force as to strew its bed with boulders for many miles. As is common with Indian rivers, stretches of open stream are divided by rapids more or less dangerous and noisy, after the hills are left behind. "During the rainy months these alternate reaches and rapids are converted into a continuous mass of rolling water. the rapids being engulfed and the whole river having the appearance of an overwhelming cataract. The water. during the dry months, when undisturbed by floods, is as clear as crystal, and the boulder bed over which it passes is visible at great depths."

The diversion from the Jumna is made in the old native style. found also in Western America and Mexico on some streams, by the annual construction of a temporary dam. In the flood season a supply is obtained in the off-take as if for mere inundation channels, but so soon as the river falls fascines filled with boulders are tipped into its shallow waters. row beyond row, until the stream is dammed, and a sufficient flow diverted. A coarse native netting covers the mouth of the fascines, and grass mats are spread on their up-stream side, and are afterwards covered with sand and shingle. The weir upon the Cavour canal. though little more solid in appearance, remains in permanency, while the Indian structure is swept away each rainy season. The construction of the last headworks of the Western Jumna canal has furnished a second source of supply to its companion on the east bank, and it thus draws from the river at Tajawala as well as at Faizabad. Three spurs stretch into the stream at its bend, and a long protective embankment runs from the Faizabad escape down the second intake. Much digging has been done in the river above and below to define its course, for though not by any means the most fickle of Indian streams it has proved the need for elaborate precautions against its surprises. The minimum discharge at the headwork is 2,402 cubic feet per second. and the maximum capacity of the canal 1,300 cubic feet per second; the length of the main artery is 130 miles, but with distributaries and cuts it has a total of 1,112miles from which it commands 850,000 acres, of which 580,000 are capable of being cultivated; the full area it could supply would be 350,000 acres, and it actually does water nearly 250,000 acres. The chief crop in winter is wheat. which was grown upon 73,000 acres out of 81,000 watered. In summer rice held the chief place, with 35,000 acres out of 51,000, while sugar cane, which embraces both seasons, covered 52,000 acres, barley was grown on 1,300 acres only, and Indian corn less than 5,000 acres. The duty of water gave 109 acres in hot weather, "kharif," and 124 acres in cold weather, "rabi," or 224 acres for the whole year per cubic foot per second actually utilised. The total average depth of water employed by the cultivators ranges from 2.5 feet in winter to 3.13 feet in summer, according to the timeliness of the rainfall. which is usually reckoned at 30 inches in the year. The water rates per acre are from 4s. 3d. in winter to 6s. in summer, or 8s. 6d. for the year, the value of a cubic foot per second ranging from £85 to £95 per annum. The total British capital expended on this canal is

£333,000, and its net revenue in 1889-1890 was £72,000, giving 21.17 per cent. on the outlay. For many years it has never paid less than 20 per cent. profit, and therefore takes its place beside the Kaveri works as one of the most lucrative irrigation investments in India.

The Agra canal may be regarded as a continuation of that just named, as it is also fed from the Eastern Jumna, and commences where the other terminates. The Agra, with the Western Jumna canal, which is included in the Panjab system, in some seasons absolutely absorbs the whole river, at their off takes, but like some American streams it regains about 600 cubic feet per second from invisible sources, which is supplemented from a cut to the Hindan River, a few miles distant. The joint-waters are then diverted from the Jumna at Okla by means of a rubble weir 2,400 feet in length, raising them 7 feet above summer level. This structure is notable as being built, without wells, or other artificial foundations, upon fine sand, the only precaution being the addition of aprons of massive stone above and below. The capacity of the canal is 1,500 cubic feet per second, and in the irrigating season it takes the whole supply in the river, but it being furnished with locks, navigation between Delhi and Agra is rather assisted than impeded, The main canal is 109 miles long, but with distributaries, navigation and drainage cuts, it has altogether 745 miles of channelling. The boat traffic only yields about 2 per cent. of the total revenue. Nearly 700,000 acres of cultivable land are underneath this canal, of which 240,000 acres could be, but only 178,000 acres actually were, watered in 1889-90. Wheat and sugar cane do not occupy an exceptional position in this area, the largest kharif crop being indigo. The duty of water is very low, beginning with 46 acres for kharif, and 79 acres for rabi, or from 127 to 162 acres a year per cubic foot per second. Yet the depth of water used is returned as only about the same as in the Eastern Jumna, so that there is evidently a mistake in the official estimates. Water rates vary from 5s. 6d. to 6s. 6d. an acre for each season, or an average of 7s. per annum; the cubic foot per second for the year being considered to cost from £60 to £70. The capital account shows £912,000 invested, and a net revenue of £43,000 for 1889-90, or 4.78 per cent. This canal has been opened for about 15 years, during which time it has paid from 2 per cent. to 6½ per cent. per annum, or an average of 3½ per cent. to 4 per cent.

The Dun canals, with their 75 miles of channels having a maximum capacity of 24 cubic feet per second, able to irrigate 25,000 acres and watering nearly 20,000 in 1889-90, represent a capital outlay of £63,000, which yields from 6½ per cent. to 7½ per cent. annually. The main crops are wheat and cereals, for which the winter rates are from 2s. an acre to 6s. for kharif, with a duty of from 80 to 100 acres per cubic foot per second a year. The Rohilkhand canals have 357 miles of channels, with a maximum discharge of 903 cubic feet per second, commanding 196,000 acres, of which 95,000 are irrigated, more than a fourth from the rivers. The chief crops are rice, wheat and sugar cane. The cost of the

scheme was £166,000, giving a revenue of £13,000 a year. The duty of water varies greatly, but is always larger in the hot than in the cold weather. According to the returns—which, it is needless to add, are confessedly unreliable on this point, and are therefore not capable of being employed to throw light upon the situation—there are considerable losses in transit upon all the canals, but where they are used for navigation waste is often a necessity, and hence no satisfactory conclusions can be drawn from the figures, which show losses of from 8 to 48 per cent. of the intakes. Drainage works are connected with each scheme, and nearly £200,000 has been expended already in the province upon this purpose alone. It is in this connection that the level of water in wells in the neighbourhood of the canals is carefully taken and tabulated year by year, as is the rainfall in each district, and the consumption of water from every canal. The plates and returns prepared in these cases reflect the greatest credit upon the officers in charge, and render their reports invaluable to the scientific student of irrigation.

The Betwa scheme stands by itself, for though the Agra canal was undertaken in part as a famine relief work it was with the conviction that it would prove remunerative to the State. The Betwa works on the other hand were deliberately sanctioned as a means of mitigating the catastrophes which follow droughts in India, and not in the hope that they would prove profitable. The headwork near Jhansi consists of a magnificent stone weir, which, unlike the majority of works in India, affords a large storage, and is built of masonry, upon a solid foundation of gneiss. The maximum discharge of the river has not yet been determined, but the canal has a capacity of 1,000 feet per sec., and commands 150,000 acres by means of 500 miles of canal. Opened in 1885-86 with a demand for water on 12,000 acres, which fell next year to 8,000 acres, this canal last year supplied 24,000, and the year before 32,000 acres, almost wholly in winter, at from 2s. to 3s. 6d. per acre. The climate is hot and dry, the cultivators as yet inexperienced in the use of water, and the wetted fields far apart. The total sum spent on the works is £416,000, and the revenue derived shows a deficit of ½ per cent. in 1887-88, and ¾ per cent. in 1888-89, so that the contribution from the State coffers has not yet ceased, though it is anticipated that, in a short time, there will be no absolute loss, but that the work will pay its expenses and something towards interest. Education in irrigation appears to proceed very slowly in Australia, and we need not marvel, therefore, if the timid, ignorant and suspicious Hindu delays and dallies with it in his turn.

The whole system of irrigation under the direct control of the department of the North-West Provinces is among the most remarkable in India, and, indeed, in the world. Its financial magnitude is of itself imposing, for the works represent a capital investment on the part of the British Government of £8,000,000, and yielded in 1889-90 a revenue of £580,000, which was earned by an expenditure, direct and indirect, amounting to £278,000. Deducting the interest due upon the loan money invested, which is set down at

£290,000, this shows a profit of the year of over £11,000, as against £8,000 for the preceding twelve months. The surplus has been as high as £180,000 in one year. In considering the variations, it has to be remembered that the Government takes the sole risk of this enormous enterprise. It provides water to sell, and takes the chances of the seasons as to whether the farmers purchase or not. Whenever the rainfall suffices, as it often does for at least part of the season, the ryots make no demand, and the State sees expensive works idle, and stores of precious water gliding by unused, in the stream from which the supply is drawn, or else discharged over canal escapes without having earned anything upon its passage, except perhaps a few rupees for motive power supplied to little native flour mills. For five years before the date for which the figures are given above, the rainfall had been considerably over the average, so much so as to injure the summer crops seriously and discourage the ryots from sowing them. These are usually most profitable to the canals, and consequently the figures exhibit their business after a series of unfavourable seasons. To this has to be added the very important fact that the Lower Ganges canal had been so terribly injured by an unprecedented flood as to have its revenue producing power crippled for several years. On the other hand the native works, of which the capital value is not stated in the returns from this province, were worth something in one at least of the systems in addition to what the Government have spent upon it, so that an allowance may be made on the debit side on that account. Nevertheless, it must be confessed that the returns under all the circumstances are most reassuring. The capital invested in irrigation in this one province is greater than that in France and Spain together, or than that of Italy as a whole. It is probably as great as that invested in the same class of works in the United States; it is more than four times as much as has been spent in Victoria upon Trust and national works together—and it pays.

This calculation has been taken in the gross so as to avoid complexity as much as possible. As a matter of fact the figures are much more favourable than appears, for here as elsewhere the State has sanctioned an expenditure for what are termed "protective" purposes, as distinguished from those which are approved as reproductive. The loss upon these works in 1889-90 was £20,000, which diminished the profits upon the remainder exactly by that sum. Then there are a series of minor works, which were expected to yield a profit, but not upon the same scale as those specially constructed with that end. In 1889-90 they earned £1,000 less than in the year before. It was the biggest schemes, therefore, which yielded the best returns, and sprang from a profit of £32,000 in 1888-89 to £91,000 in the following twelve months. Even with the Lower Ganges canal, which, because of its accident, was brought down from a profit of 4½ per cent. to 1¾ per cent., the great canals paid almost five per cent. net upon their capital outlay, and after clearing all expenses, including interest, gave a surplus of £32,500 for the year.

Under the Government canals there were 1,900,000 acres irrigated in 1889-90, showing that the area is steadily creeping up to the 2,300,000 acres watered in 1883-84, a total to which it is likely to rapidly approximate now that the Lower Ganges scheme is coming into full working again. The practice is to reckon that land should be watered once every three years if a district is to be fully supplied, so that the area affected by these works may be roughly set down at 6,000,000 to 7,000,000 acres for the capital cost of £8,000,000. The estimate for Victoria has been that with £5,000,000 it would be possible to command 3,000,000 acres, a figure which, taking into account the cheapness of labour in India, is not discouraging. But in the North-West Provinces there is a large area under irrigation which owes nothing to State expenditure, and which is liable to be overlooked by those who concentrate their attention merely upon imposing canals. Nor is this area subsidiary in any way to that watered by the Government works. On the contrary, here, as elsewhere in India, its extent far exceeds that of the country that is canal supplied. The estimate is that outside of Oudh, there are 5,000,000 or 6,000,000 acres privately watered, and that in Oudh what with jheels, or natural reservoirs, and river overflows there are 3,000,000 acres watered, though in that district there are no Government schemes at all. This gives for the whole province as now bounded, though it is not much larger than Victoria, something like 10,000,000 acres wetted annually. How many English people realise that in this one subdivision of one presidency in India there is more land irrigated annually than in Egypt or the United States, or indeed in any country in the world of which we have exact knowledge? How many know how well it pays, not only the people who live by it, but the State that has invested £8,000,000 of its own money in the enterprise? The North-West Provinces have received for the last sixty years eight per cent. clear profit upon the capital invested in water supply.

CHAPTER VII.

IRRIGATION IN THE PANJAB.

"God has said, from water all things are made. I consequently ordain that this jungle, in which subsistence is obtained with thirst, be converted into a place of comfort." Such was the ukase of the great Akbar in 1568 in connection with the inundation canal to Hansi, constructed by Feroz Tughlak in 1355, but which had long since fallen to decay. The Hissar district was an endowment which the emperor was at that time bestowing upon his son, Muhamad Salim, whom he styles, "the great, the fortunate, the obedient, the pearl of the ocean of my kingdom, the star of my Government, the praised of the inhabitants of the sea and land, the apple of my kingdom's eye." It was to be watered that it might become worthy of so distinguished a prince. This did not imply much. The earliest Indian irrigators sat at the feet of nature, and aimed at little more than adapting the natural channels of the country to their purposes. Their first efforts in this tract were directed to the improvement of the course of the Chautang, now for the greater part of the year a dry watercourse, but then a flowing stream. There is no accurate record of what Akbar did in tho way of canal construction, but it seems that he led the water of some minor streams into existing channels, which he deepened and widened. A century later Shah Jehan once more repaired them, and brought an important branch to Delhi, but it is still doubtful whether up till then the Jumna had been utilised at all. We can dimly discern a shifting of the slope of the watershed from the west, where originally its waters poured down to the Indus, to the east where they have now for some hundreds of years swerved round into the Ganges. Possibly this alteration in the line of catchments might account for the failure of Chautang and of the works which depended upon it. The first canal lost its supply after about 120 years; the second needed remodelling in 60 years, began to fail in another 80 years, and altogether ceased to run 50 years after.

Lieutenant Blane succeeded in 1821 in bringing a small instalment of the waters of the Jumna into the old Delhi canal, and restoring a portion of the supply which had been wanting for more than 60 years. Crippled by want of funds and the timidity of his superiors, he was only enabled to construct temporary works, utilising natural channels and crossing depressions by means of earthen

banks. These, of course, seriously interfered with the drainage of the district and led to the formation of swamps, while the occasional collapse of the banks was the cause of widespread injury to the villages and their cultivation. From 1823 the work of replacing the temporary banks by aqueducts and bridges went slowly on, the Government with foolish parsimony undertaking the substitution piecemeal, and allowing the whole country side to suffer from their neglect. The flow was uncertain, the rates high, the outlets insufficient. The famine of 1832-33 led to the enlargement and multiplication of channels, but these were executed in haste upon imperfect information and with bad alignments. In 1841 the canal had reached the limit of its capacity, but was faulty in many respects, from its headworks, which often failed when most needed, to its distributaries which were too numerous and erred in their levels. By 1847 an expenditure of £138,000 upon permanent works had swollen the cost of an imperfect and unsatisfactory scheme. In 1820-21 the canal watered 20,000 acres. In 1832-33 the area had risen to 94,000 acres, and in 1842-43 to 400,000 acres.

The progress made, however, was dearly bought. Expensively constructed as they were, the canals carried above the level of the country in porous soil, saturated the lands below them. No proper provision having been made to prevent the entrance of silt, and the slopes having been at times excessive, there were large deposits in the beds of the lower channels, which being yearly removed at considerable cost, formed embankments, in places 15 feet high, across drainage lines. They sometimes consisted of loose sand, which the wind scattered upon adjoining fields to the injury of their productiveness. No check was put upon over irrigation, while careless cultivators, too indolent to grade their field in steps, poured sufficient water upon them to flood the highest portions, and thus soaked the lowest much more than they needed. Little care was taken to repair breaches of the channels, and none to provide drainage. The consequence was that whole tracts became water-logged, in seasons of heavy rain the surface of the country was covered, and the water being retained by the banks of the canals and distributaries, the crops in many places were literally drowned. The soakage from below brought to the surface of the soil its saline constituents, and, as the sun evaporated the moisture, these accumulated until a white glistening crust was formed, looking like snow. This not only effectually destroyed all herbage and possibility of cultivation and afflicted with disease the cattle, who fed upon such grass as sprung up upon partially covered land, but being blown upon the adjacent fields, spread the same evils far and wide. The marshes bred malaria to such an extent that 60 to 80 per cent. in many villages suffered from enlarged spleen and yearly attacks of fever. There were epidemics in 1841 and 1843; famines in 1851, 1859, 1869 and 1875-77. There were some positive engineering blunders also, such as the excavation of the Rer escape, which caused the formation of a marshy lake close to the city of Panipat, destroying vegetation and impairing health, while the Burra Khena escape unneces-

sarily occasioned a great deal of saline efflorescence in its neighbourhood. There is no dispute as to the magnitude of these mistakes. In 1867 General Strachey declared that "The portion of the canal near Karnal is a disgrace to our Administration, and has been for years past. It creates most pestilential swamps, not only destructive to the health and life of the population, but occupying in a manner far worse than useless some of what might be the very best lands."

It was in 1873 that the task of remodelling the canal as a whole was put in hand. Up to that date £300,000 had been expended upon a system which, though remunerative to the State, had done great injury to the district through which it ran, and to the people inhabiting it. As usual, the new plan, which was to cost £721,000, was found quite insufficient when it came to be put in execution, and accordingly the work of reconstruction has been continued until a year ago, with the result that a new scheme has been substituted at a cost of £1,600,000, more than five times the original outlay, and more than twice the first estimate authorised. The old design has been abolished, and the Western Jumna Canal is now entitled to be ranked among modern works of the first class. The old head was Dadupur, where from 1823 to 1833 and later a struggle much of the same kind as that at the head of the Ganges Canal, was maintained with a shifting river. The new head at Tagawala, some miles higher up, presents the same difficulties. There are many islands and sand banks, which have been united by bunds so as to confine the stream within two main channels. Until recently reliance was placed upon a temporary weir of shingle 500 feet in length, but this has now been made permanent in masonry, and fitted with falling shutters, raising the water 8 feet above the former crest. A line of works on both banks enables water to be directed into both the Eastern and Western Jumna Canals, which are furnished with regulators, to determine their supply. These are supported along the new line of the canal by permanent works of the latest type, among which the Indri escapes and regulator are the chief. The canal still derives an additional supply from hill drainages to the west, which are introduced under cover of equally substantial dams. The main channel, 84 miles in length, has been re-aligned for the great part of its course, as has the important Delhi branch, and most of the distributaries. Drainage works have been freely introduced in the shape of syphons and escapes, while a considerable portion of the old canal and many natural gulches have been applied to the same purpose.

The new scheme now commands 555,000 acres, distributing 2,800 cubic feet per second, by means of 1,200 miles of canal and distributaries. The river supply from November to March, 1889, ranged from 2,296 to 4,881 cubic feet per second, being affected to some degree by the off-take of the Eastern Jumna Canal, situated a little higher up than that of the Western. Its minimum is fixed at 1,666 cubic feet per second. In 1889-90 the river was in high flood for some time, destroying the floor of two bays in the under sluices, and sweeping down some of the training works. The Jumna, however is a fairly settled stream, and gives less trouble than the

Ganges to the east or the Panjab rivers to the west, which require much more expensive works and continous efforts to keep them to suitable courses. The area irrigated is on the increase, having risen from 223,000 acres in 1885-86 to 419,000 acres in 1889-90, largely in consequence of the completion of the works, though in the famine year 1877-78 it rose to 508,000 acres, and may attain that figure again under pressure. Almost the whole of this is accomplished by gravitation, less than 6 per cent. of the acreage requiring the water to be raised above the level of delivery. The duty obtained on this canal was formerly reckoned the highest in India, but the latest returns do not support the ancient figures, for the duty does not exceed 75 acres either in summer or winter on the average of the past few years. The cost per acre amounts to 4s. 3d. in winter and 5s. in the summer, for ordinary crops. The favourite in winter is wheat, which occupies 184,000 acres, or 43 per cent. of the whole cultivation, rice coming next with a summer area of 38,000 acres. Sugar-cane has been on the decline of late, varying from 27,000 to 54,000 acres. Requiring water in both seasons it is a profitable crop for the canal, and usually for the ryot also. The main channel is navigable throughout, and the returns from this source show a steady increase, reaching £6,300 in 1889-90. In spite of the great cost of the scheme, which has not yet borne its full fruit, the canal showed 6 per cent. returns on its £1,800,000, or, deducting interest, a net profit of £24,000 to add to the profits of former years, which have together not only recouped all expenditure upon the works, working expenses and interest on capital, but have put nearly £3,000,000 extra into the public treasury.

It is at least equally satisfactory that the terrible evils complained of as resulting from the canal are fast disappearing. The greater swamps have disappeared, and the remainder are being gradually dried. The soil is being drained, and when that is done, it will be possible to attack the reh and wash its salts gradually away back into the depths of the soil, or in solution down the river courses. In famine years, poor as it was, the system has on several occasions saved crops worth one or two millions, and the tens of thousands dependent upon them. In the future it will be enabled to do this more extensively, while it will no longer be chargeable with the losses and sickness which accompanied its beneficent work in former times. A huge extension is now under construction, which will, by means of a canal carrying 865 cubic feet per second for 138 miles, feed 528 miles of distributaries and water 185,000 additional acres at a cost of £470,000. The district of Hissar, so prized by Akbar and his son, enjoyes a supply to-day far larger and more regular than that which he was enabled to give it, large as were his ideas and princely his generosity; but, in addition to this, what would have seemed to him perfectly impossible is coming to pass, since the waters of the Jumna will be supplied to the great territory to the north, extending as far west as Sirsa, while on the east another branch of the same great scheme, supplying the fields right up to the walls of the imperial city of Delhi, will enable

it to water altogether three-quarters of a million of acres at a cost of £2,250,000. A reproach has been removed from British rule, which military engineers and administrators were chiefly responsible for in the first instance, and the removal of which has come in great part from their military successors. Both in the north and south of India the English have been indebted to the natives, who first showed them the way of irrigation, but in both cases it must be admitted that they have immensely improved upon such ancient schemes as they found, and have now, after many years of experiment, succeeded in modernising the whole of them.

The condition of the ryots to-day in India is exactly the same as under the Mughals, and indeed for centuries before their sway, and the facts to be faced in the districts around Sirsa are those which confront the Government of India and their engineers at every turn. Colonel Wace, Financial Commissioner of the Panjab, has reported upon the prospects of the farmers of this part of the province in plain terms, which apply so generally as to be worth quoting :—"Their all," he says, "is staked on a rainfall, usually less than 20 inches, and if that fails the heavens are brass and the earth iron, in a sense which those only know who have lived in those tracts at such seasons ; the rivers are miles away ; the cattle die of thirst as much as of hunger, and the people themselves have a hard fight for their lives, living on wild berries, grasses and roots." There have been seasons, such as in 1783, when even these foods failed—when the country became absolutely depopulated. All the improvements that the people can point to are of later date, and have been introduced since that awful calamity. The conclusion of Colonel Wace, who is not connected with the Water Supply Department, is perhaps all the more acceptable on that account, when he says that railways may prove a palliative, but "the only real insurance against and effective prevention of the evils is the distribution to each village of a moderate irrigation supply. When this has been done, each village can stand on its own resources ; men and cattle have sufficient food in bad years, and in good years abundance ; and the fluctuations in the annual aggregate collections of revenue and of local rates are confined to moderate limits." Such is the verdict of a dispassionate critic, and every humanitarian must rejoice with him when he sees a stream of water more than 100 feet broad directed from the old canal and taking its way across the plains to a district described as one of the first to suffer from famines in the past, and now reasonably secure against them for the future.

The history of the Western Jumna is worthy of special note because it points to the unwisdom of courses of procedure which have been recommended in the colonies in recent years. It is not wise that we should feel our way by means of a series of experiments which have been already made for us in other parts of the world ; it is not to be desired that our schemes should be initiated at the easiest spot at which any supply can be obtained without scrutiny of the districts as a whole, that they should then be allowed to grow piece meal from the first beginning, just as local interests may

determine; it is not right that we should wait for droughts to authorise sudden extensions, upon imperfect information, to meet unexpected needs. It would be impossible to determine the amount of money which has been wasted on the Western Jumna in various temporary expedients and discarded works, but it is certain that at least from £100,000 to £200,000 might have been saved if the existing scheme had been outlined in the first instance, and if, so far as it went, it had been built upon one plan as necessity for its extension arose. Unscientific planning and unsystematic construction are always costly in this or any other branch ef engineering. So far as anything has been done in Victoria up to the present time it may be fairly claimed that the expenditure upon irrigation has been undertaken upon lines of which little or no alterations will be needed; that in the event of emergencies arising, information is ready to hand, and that in most cases the principal works are constructed on plans which would enable expansions to be undertaken at short notice and with confidence in their relation to the general design. But, to criticism of the Jumna Canal there is one sufficient answer which disposes of ali complaints on the score of extravagance therein. The State has been absolutely repaid the whole sum which it has as yet spent on the works, and £1,000,000 to boot. It will probably be a very distant date before the same can be said of the irrigation works in Victoria, though built to some extent in the light of Indian experience.

The division between the Panjab and the North-West Provinces by the channel of the Jumna is quite arbitrary, and from an irrigation point view the Western Jumna Canal should be considered as forming part of what is officially called the North-west, and which is more correctly entitled, by Jackson, the North-eastern system. Not only are the streams and their sources of supply, and the direction of their fall the same, but the climate and crops are the same, and the people are very similar also. The canals are, if not of antique construction, upon the sites of Mughal works, and the English engineering commenced in the early part of this century. The Panjab proper is a territory of other characteristics, consisting of the Indus watershed, of plains more arid and more cool where there are no ancient canals worthy of notice, and where the British have only settled and operated practically during the latter part of this century. The Jumna and the Ganges with their great canals commencing close together at the foot of the mountains, and with two others some distance further into the Doab, mingling or supplementing their waters, constitute a network of irrigation supply far larger than is to be seen in Northern Italy, or indeed, in any part of the world; greater even than the Nile delta, though that could not fairly be put in comparison. Yet the Panjab is a dangerous rival, and if it does not exhibit its schemes in such close proximity to one another, nevertheless in their magnitude and extent bids fair to surpass even the hitherto unsurpassed North-west.

The Sirhind canal, drawing its water from the Sutlej, has its branches close up to the water-shed of the Jumna, and, indeed, a

navigable channel is proposed to be constructed from one of these below Patiala across to the Western Jumna Canal. When this is executed it would be possible to ascend the Ganges from Calcutta to Delhi on the Jumna, and, passing thence into the Sutlej, descend into the Indus, having made the circuit of Northern India from the Bay of Bengal to the Indian Ocean by water. Beyond the Sirhind we come to the scarcely less notable Bari Doab canal, tapping the Ravi near Mahdopur. These are worthy of being matched with the Jumna and even the Ganges canals. Beyond them again lies the Chenab canal, under the river of that name, at present a considerable scheme, but in course of enlargement so as to take its place with the two former. Beyond this again the Jhelum project is outlined, destined to occupy a great place in its Doab, while still further north and west on the very confines of Afghanistan, and at the edge of British territory, is the Swat canal, like a triumphal arch of peace and prosperity erected in the very sight of the marauding Pathans, and within range of their rifles, to demonstrate the daring Anglo-Saxon policy in Asia. These five schemes, of which three are executed and another in partial operation, when taken together will overtop the North Western totals, if the Western Jumna be counted in the Panjab as at present, and will give that province a decided supremacy in Indian canal irrigation if all its minor schemes be thrown into the balance. Setting aside the little done on the Western Jumna, the whole of this will have been achieved by the British, and in less than half a century from the conquest of the country.

In addition to the great canals which have been mentioned, the Panjab has here and there thick fringes of minor canals from its chief rivers. There are a cluster to the west of the Sutlej, above Fazilka, and another set lower down the same river by Bahawalpur towards which again flow a group from the east of the Chenab, and high up the Jhelum a string of short cuts along the Shahpur shore. The Indus, below Leiah, has a series on each bank like vertebræ, stretching down to Mithan Kot. All these are inundation canals, and if we look southwards beyond the Panjab border we shall find the whole of the canals of Sind, with one exception, of the same class. Those who have noted the effluents of the Murray will have observed the outlets which nature makes for surplus river waters. These have only to be conceived as somewhat straightened, and carried through a much drier and less wooded country to represent in a general way the character of those artificial diversions, with the difference that they do not return their water to the rivers again above ground, except when the intake is larger than the consumption in the fields. The dependance of the country upon these canals is best realised when the deficient rainfall is taken into account, for the average over a series of years is but 6 to 7 inches on the plains, and but 13 inches at Shahpur, immediately under the hills. Even this fall is liable to be unseasonable, and has a wider variation in time than in Eastern or Southern India, so that the great plain is usually as dry and barren as the driest and poorest parts of our own mallee. The whole of the

Panjab except a narrow belt under the hills suffers from the same dearth at times, but in the central portions cannot even rely upon a perennial supply from its streams. It is for this reason that its people are obliged to trust to the river in flood, when the diversions above are not felt, and its torrents are rushing turbid and troubled from their Himalayan home away to the distant sea. When the river is low they suffer severely, and are pinched at once. Were the flood to fail in any season they must either find corn in some contiguous Egypt, or die unfed. Fortunately the rivers do not fail, and are rarely low; they are high owing to being snow fed in the summer season, just when water is most needed. The chief damage is done by floods, which not only change the course of the river occasionally, but, entering those canals which are provided with regulators, silt them up at the heads and flood the cultivation under them, cutting escapes across the fields, and drowning crops in the hollows. On the whole, however, this source of supply is much more constant and even than might be supposed, and the tens of thousands who throughout the valley of the Indus commit their seed to the soil with confidence in the rising of the river, reap their harvests peacefully year by year, and find that they have not put their trust in vain.

Perhaps it is for some such reason that Kailasa, the Paradise of Siva, of which the temple at Ellora is a model, and to which his faithful devotees trust to be transported after death, is definitely located, though invisible, among the Himalayas on the borders of the Tibet, whence the Indus itself and its greatest tributary, the Sutlej, take their origin between 15,000, and 16,000 feet above the sea. The latter issuing from two sacred lakes, piercing the depths of the mountains, dropping from gorge to gorge, and thundering down a rocky bed, emerges into British territory over 1,000 feet above the sea, and after a course of 900 miles joins the main river. The Indus itself, after an early career as turbulent, breaks through the Western Himalayas by means of the Iskardoh Gorge, estimated to be 14,000 feet in depth, and flowing down the eastern side of the Suleimans, which divide India from Baluchistan, receives into its capacious bed the four great tributaries, which, like the outspread fingers of a giant hand, stretch across the plain to the far off valleys of the Himalayas, whence they derive their perennial streams. In the upper portion of their course they have a considerable fall, running at the bottom of deep and well defined valleys much below the ordinary level of the neighbouring country, to which they afford no supply, but which from its proximity to the hills enjoys sufficient and regular moisture. Beyond the belt so visited, however, the low lying land receives an extremely precarious and usually deficient precipitation, while the rivers wander in wider tracts with more uncertain course and with considerably less fall. The canal system of the Panjab consists in tapping them in the higher valleys, and conveying the necessary supply to the arid plain below. Deducting the 800 miles which the Indus passes beyond British territory among the mountains, and that proportion of its 372,700 square miles of drainage area, the province consists of its basin, from the hill sides whence its brooks come, the slopes where

streams are fordable in dry weather, to the level country and its rivers uniting in one channel, with a flow of from 41,000 to 446,000 cubic feet per second, and an annual discharge of 5,383,000,000,000 cubic feet. Heavily loaded in the rainy season with fine clay, carbonate of lime, micaceous sand, salt, nitre, and carbonate of soda, this stream is distributed by means of inundation channels over the cultivated area of Sind, to end under fierce unsparing heat in a desolate net work of mud banks, shallows and brackish coast lagoons bearing no reminiscence of the purity which it has lost or of the plenty which it has distributed, of the fresh and bracing breezes, or of the sombre and terrible glories of its birthplace amid ice peaks and eternal snows.

Cancelling 24,000 square miles returned as unculturable, from the surveyed and assessed area of 95,000 square miles capable of being farmed, there is left 45,000,000 acres fit for cultivation, of which five-sevenths is under the plough. The total rental paid exceeds £5,000,000, of which about half goes to the State. There are few large towns, and, as in the rest of India, few of the 34,000 villages of the Panjab exceed 1,000 inhabitants, the average being 549 in each, and 177 persons to the square mile. Up to the census of this year there were no returns from Bengal proper, and hence, although smaller than Madras and Bombay, and the same size as the North-West Province, the Panjab showed the largest area under assessment, and the largest cultivable area yet untouched in any of them. There is more private irrigation in the North-west but the native schemes in this province have a character and a history which is all their own.

To form a complete idea of the irrigation of India, it would have been necessary to have dealt at length with the native and minor schemes which supply vast areas in each Presidency, but as these have no bearing upon Australian conditions, they are omitted from these papers, The local system in vogue in the Panjab, however, is of such a size as to call for some comment, more especially as it has been to a large extent adopted and developed by the Water Department. The native works in existence at the annexation of the country provided only for inundation, were most of them small, all of them simple in plan and rude in execution. They were constructed originally by a kind of partnership between the land owners interested and the political ruler for the time being or his officer. A resemblance may be traced between this primitive combination and that which theoretically underlies the Victorian Acts. The contribution of the people, in labour, supplied all that was necessary to inaugurate and maintain each little scheme, the task of the officials being merely to enforce unity and generally direct the operations of those concerned. Recalcitrant minorities were coerced, and occasionally the labourers were fed, though rarely paid, by the representative of the local chief, who took a liberal allowance for his services in the shape of rent. The Australian practice of advancing money and levying a special tax for interest, instead of requiring labour and trusting to a general impost on land, does not

alter the principle of co-operation between State and people implied by the rough and ready partnerships of the Panjab. The cardinal difference is in the administration, by which in Asia the ruler secured the lion's share of the profits of the joint undertaking, while in democratic countries the locality generally comes off best.

In sub-Himalayan tracts there are numbers of little canals, made, owned and worked by the small communities which they supply, without any reference to the Government at all. In the khadirs of the rivers there are rude cuts in the banks by which supplies are obtained in flood time for small areas in an equally unofficial way. There are in and around Dera Ismail Khan patches without perennial streams, but where the gushes of the rainy season are caught by long embankments or diverted from natural channels, so as to wet the lands under them sufficiently to secure a crop. In Dera Ghazi Khan there were, and in Shahpur there still are, small private canals constructed by men of capital, who usually require about a fourth of the produce of the land as payment for the water. These are discouraged by the Government, which in the former district has bought out the private owners, and everywhere rigorously asserts the State proprietorship in all streams. The Victorian Act claims this just as distinctly, but the rights logically flowing from such a title have not been defined or enforced. One hears nothing of riparian law in India. The earlier it is reduced to statutory provisions and precise limitations the better will it be for the colonies, which at present suffer, as California did, because of the importation of a Common Law which on this point is out of joint with all their conditions and public interests.

The Khanwah canal was cleared out by the Sikh Government shortly before its fall; both there and in Dera Ghazi Khan, where the Sikh Governor undertook a similar responsibility, the British stepped into his shoes and accepted the same policy of control. But elsewhere in the Panjab they continued another system which had prevailed for unknown periods. The work done each year is estimated by the officer in charge, who determines the number of days of labour required to perform the annual clearence of silt, repair banks, adjust the head work, and make such improvements as appear desirable. He then takes the list of applicants for water, and divides the labour among them in proportion to the benefit they are to receive. Each of them is under obligation to provide his own or other labour as required, or to pay 1s. a day as *zarinagha*, or cash commutation. The season for work is reckoned at ninety days, so that large irrigators have to pay £4 10s. per man levied upon them. The irrigated area for which one man would be required averages twenty-five acres. As a matter of fact money is rarely paid and labour is always forthcoming. This is known as the *chher* system, much criticised by some officers, who prefer the *dak*, as a general demand is termed, made upon a village as a whole, for the clearance and repair of a particular measured portion of the canal in its neighbourhood, the distribution of the work, and within certain limits the time of performing it, being left to each hamlet to settle

for itself. Up till lately, if not now, these systems were not recognised by law, but yet were universally enforceable by custom, and the inclination of the people for their perpetuation. The British have always shunned the corvee or forced labour, and anything that approached it, preferring the more exact system of money charges for services rendered, and money payments for services required. Here, as in other cases, however, native traditions and tendencies have been too strong for English prejudices, and just as in Fiji taxes are paid in kind, so in some parts of India the responsibilities of landed proprietors in connection with canals are discharged to this day in labour.

There seems no sufficient reason, where injustice is provided against, why there should be any attempt to alter an equitable method of distributing responsibilities. Lieutenant-Colonel Grey when he entered the Ferozepur district in 1874 found large areas capable of being watered lying barren and idle. Obtaining the services of a surveyor, borrowing small sums from district grants, and securing *takavi* loans for the larger farmers, he marked out canals and allotted to each village its share of excavation. By 1875 he had 256 miles of channel in operation; from 1877 to 1880 these were neglected in his absence. On his return he again resumed control, and imparted such a stimulus to the people that by 1883 he had induced them to construct 600 miles of inundation canals, varying from ten feet to five feet in bottom breadth, by which, at a cost of only £47,000, nearly 100,000 acres are irrigated annually. The sums borrowed from district funds and the *takavi* loans were all repaid. Extensions have been pushed on since, so that now there are 650 miles of channel and 120,000 acres irrigated each year without the expenditure of a sixpence of Government money. The canals belong to their districts, and are owned and maintained by the farmers under European guidance. This remarkable result testifies to the soundness of the system, and indeed might be fairly quoted on behalf of local responsibility and local management of irrigation schemes everywhere.

Native assistants, watchmen, patrols, gauge readers and overseers are employed upon all canals, but in those of the Panjab dependent upon inundation there is in addition a *Panchayat* or committee attached to each. This consists of land owners nominated by the district officer, and acting with, for, and under him, in supervising the clearances, and generally in managing and advising. The members are paid by a remission of the *chher* levy upon them, and can only be dismissed for cause, with an appeal to the Commissioner. In Muzaffargarh there are *Sarpanches*, who perform the same duties and are similarly remunerated, while the *minhars*, or water bailiffs, are paid by the irrigators in cash or in grain. The employment of numbers of Hindus is easy, because of their cheapness and of the simplicity of the routine duties they are called upon to perform. Even in these they need the strictest supervision, not only to check their indolence, but to resist the almost universal tendency to favouritism and corruption which exists among them. Their

association under and upon committees is immensely advantageous, inasmuch as it links them with the undertakings, trains them, organises them and teaches them the ability and sincerity of their masters. The feeling of community of interest compels the villagers to work together, and with the European officer who presides over the works from which they receive their harvests. In this way a bond of mutual trust should be created capable of standing strain in time of need. Possibly the process may now be going on, but confidence is a plant of slow growth, and there is but little discoverable as yet upon which the white can rely.

The position of the canal engineer, arduous everywhere, has special difficulties in these parts of the Panjab. As Deputy Commissioner Gladstone remarked :—"Inundation canals are very simple when they are understood, but they require the experience of years. . . . To deal with inundation canals a man must be always on the spot, must be thoroughly acquainted with the practical geography of his circle, and must learn that rules of hydro-dynamics can not be always applied to the Indus. He must, to a certain extent, forget that he is an engineer, and he must acquire an instinct." The task here, like that of the Mississippi pilot, as described by Mark Twain is one to be learned from the facts and by practice only, for the engineer has to deal with capricious and shifting rivers much in the same way as the pilot and with as little time for deliberation in hours of trial.

The major inundation canals are not to be confused with those smaller offcuts which have been referred to above, for they are works not only of great size, but of the first importance, and rank among the most profitable investments in the Panjab. Some of them have permanent weirs to accomplish their diversion, and are from 60 feet to 90 feet wide at their mouths. A few of them are of considerable antiquity. It is believed that the Khanwah was begun in the days of Akbar, being then 63 miles in length and 60 feet in width. The Afghans who ruled after Aurungzeb added to its proportions, but a change in the course of the River Beas, from which a supply was then drawn, rendered the district dry and desolate for many years. It now possesses 300 miles of canals, irrigating 147,000 acres. Owing to their dependence on the rise of the river they are unable to yield the supply necessary for maturing the *Rabi* crops in the cold weather. They give one watering after the sowing, and then leave the cultivators to depend upon their wells when the stream has lost its volume. This system has two large main channels besides the Khanwah—the Kotara, which in 1889-90 carried 718 cubic feet per second, and the Upper Sohag 553 cubic feet per second, added to the 1,179 cubic feet per second of the chief offtake. The Kotara is dependent upon a temporary weir, renewed each year, while the other two have permanent headworks. The Lower Sohag was originally constructed by a local landowner. Rice and cotton are the chief summer crops, but wheat, the winter crop, equals the two together in its area, which is steadily on the increase. In addition to this the canals water a large number of orchards and

groves of date palms, beautifying desert places and yielding an excellent supply of fruit for the parched throats of the people. These works are now being extended, so as to irrigate the land above the Upper Sohag; while a bold project is approved, though in abeyance at present, for a great head from which the whole of these canals would be supplied with certainty, and a much larger area watered, by means of a masonry weir at Ferozepur. At present the whole of this group only represent a capital of £60,000, but pay nearly 10 per cent. upon that sum, and show a surplus to date of £5,637.

The Sidhnai canal takes off from the Ravi, just before it joins the Sutlej, by means of a permanent weir 800 feet long diverting up to 1,000 cubic feet per second into 150 miles of channels, irrigating 110,000 acres with a summer duty of 60 and a winter duty of 85 acres per cubic feet per second. The weir is built in clay, with a crest wall 4 feet thick, having a slope of 1 in 3 up stream, pitched 18 inches thick; and 2 feet thick down stream, with a slope varying from 1 in 3 at the bank to 1 in ten in the centre. It rests for some distance upon piles, no solid foundation being obtainable, and is fitted with pillars, carrying a beam, in which needles are dropped so as to raise the water six feet in the dry season. The toe of the down stream slope is strengthened by a line of boulder-filled crates. The regulator to the canal has eight openings of 10 feet each and a lock, in which also needles are employed. The whole scheme is modern, and exhibits much ingenuity in design and detail. Owing to variations in the height of the river, injudicious cultivators occasionally lose a proportion of their crops by delaying their applications for a supply until too late. In 1889-90 the losses amounted to 24,000 acres, although the canal ran for 208 days during the year. Three minor canals are now being constructed so as to combine with the Sidhnai, which will bring its cost up to £100,000. Up to date £83,000 has been sunk in the single canal, which has earned 15 per cent., and left, after payment of working expenses and interest charges, a net profit for 1889-90 of £3,000, and a total of £10,000 to the credit of its accounts.

The Lower Sohag and Para is a new scheme, which began in 1885-86 with 17,000, and has risen to 63,000 acres irrigated from 132 miles of channel, carrying 727 cubic feet per second during 144 days to crops valued at £169,000. An alternative head is being constructed for this canal, the banks of which are not yet quite settled all along its course. It is £500 a year short of its interest, and has £9,000 to make up; no doubt is entertained but that this will be speedily accomplished. The Lower Sutlej and Chenab canals include 132 canals 768 miles in length, watering 363,000 acres, bearing crops valued at £1,000,000, distributing 10,860 cubic feet per second during high flood, at a cost to the cultivator of only 3s. per acre. These canals are dependent upon the *chher* system, and one of the consequences was that as in 1889-90 there was a low river and much silting, which meant heavy work for repairs, many of the ryots preferred to pay their *zarinagha* fines instead of labouring

themselves. There were over 100,000 days' work to be paid for, and £6,000 was collected on this account.

The canals differ in duration of flow, some falling below 100 days in the year, and others rising above 200 days. It is difficult to estimate their capital value, so much of the work upon them having been done before the British rule, or by *chher*. As only 11,000 stands to the debit in the books of the province, they appear to be earning 217 per cent., and have accumulated surpluses amounting to £23,000.

The Indus canals involve another set of problems, and their working is attended with many difficulties, on account of the exceptional nature of the river. There is first the task of keeping a connection with its stream, which wanders in its wide bed from side to side of an extensive Khadir, while if the connection made be too direct the enormous floods which it carries in the rainy season not merely close up the channels with thousands of tons of silt, but eat away stretches of country, and, forcing their way into the canals, burst ther banks and turn their upper portions into branch river channels. Fifteen in number, from 8 to 116 miles in length, they have a total of 709 miles of channel, and in 1889-90 watered 214,000 acres, chiefly of millet, wheat and cotton. Some of them are 60 feet wide and run 6 feet deep, while others are of much narrower proportions. In the case of many, temporary bunds require to be constructed each year to obtain a supply, while in others they are necessary to protect the headworks or portions of the canal. The river is embanked for miles to ward off inroads such as those of 1871-72 and 1878-79, when a whole country side was devastated. About £10,000 a year is spent on silt clearance, and in bad years this sum is often largely exceeded. The minimum flow of this magnificent river in 1889-90 was 23,337 cubic feet per second. The Shahpur canals, with their 131 miles of channel and and 17,000 acres watered, and the Muzaffargarh 13 with 1,200 miles watering 281,000 acres, merit no special mention. They pay well and assist their districts to produce largely. Sind repeats the same lessons upon a larger scale, and demonstrates that inundation canals must not be despised since, with all their disabilities, they are a great financial success.

The modern canals of the Panjab are, almost without exception, perennial. The three chief, representing Indian irrigation at its best, have been already criticised, but when the Western Jumna, the Bari Doab and Sirhind have been dealt with, there remains one out of the many systems the origin and results of which demand more than a passing notice. The system is that which lies in the valley of Peshawur, beyond Attock, in the corner between Kashmir and Afghanistan, the farthest point to which railway communication has been extended, and the utmost limit of India and of British territory. Beyond this valley are the hills of the Hindu Koosh, with their wild tribes levying toll on the armed caravans that take their way to Kabul or the central Asian markets beyond. The fierce extremes of heat and cold to which this region of the far

north-west is subject to do not appear to injure its productiveness, but rather to multiply its varieties of growth. Yet nothing is possible without moisture, and as the annual average rainfall is below 15 inches, and has been as low as 5 inches and 9 inches, this implies irrigation. For miles around the country is barren and desolate, treeless and shrubless from the black plain to the bald hills; about it is an inhospitable land peopled by predatory marauders whose ancestral profession has been pillage, and whose disdain of industry and husbandry are truly feudal. Among the items of cost on the canal were included sums for military guards required for the protection of working parties. During its construction every engineer's bungalow was a fort from which none ventured after dark, and which every night was guarded by sentries. No admission was granted to strangers or natives until they were searched. This happened only seven or eight years since. Even the villages which possessed inundation canals fought with each other about rights of diversion, spilling much blood as well as water in the struggle. In such a country and for such a race the British Government built the Swat canal.

The first propesals for construction emanated in 1870 from Sir Henry Durand, Lieutenant-Governor of the Panjab, and after much consideration and elaboration, were authorised in 1876, They provide for the irrigation of the high-lying land to the south-east, between the Swat and the Kali Pani torrent that flows into the Indns below the junction of the Swat and Kabul River with the greater stream. There are remains of what appears to have been an ancient canal in this part, and the lands near the tail of the Doab are still inundated each year by the villagers, who are also able to draw upon wells for a part of their supply; a thing impossible in the upper valley. The headwork on the Swat, a few miles above the foot of Abazai, is a masonry weir diverting 700 cubic feet per second out of a stream which has a minimum of 1,172 and a maximnm of 158,000 cubic feet per second, into 148 miles of channel, watering 120,000 acres. The river could increase its supply and the country to the east of Kali Pani could readily absorb it, but the surveys indicate so much difficult country that the project has been abandoned, although the constuction of additional minor channels is expected to add another 10,000 acres to the watered area. A certain amonnt of irrigation is allowed directly from this canal, owing to the great fall from it and the necessity for supplying every acre possible, but this is the only place in India on which such a practice has been permitted. The difficulty upon this canal was the fact that it was carried across the drainage line of the country, which is seamed with watercourses, the smaller of them resembling the gullies cut in the bare slopes to Australian rivers. Thirty of these nullahs, as they are called, are crossed in as many miles, one of them by an aquednct of seven arches of 40 feet each, and another half a mile wide and 19 feet deep by one of 40 arches.

One expedient adopted by Mr. Stuart Murray in the Waranga basin, and made the subject of much animadversion by Victorian critics,

was the carrying of a small channel upon an artificial bank 20 feet high. According to the eminent authorities on engineering who abound in all districts this was asserted to be the wildest of escapades and most unreasonable of designs. It may or may not modify their opinions to learn that the Swat canal, with its 700 cubic feet per second, is carried upon a similar bank 60 feet high with perfect safety. Its construction cost a great deal of money and pains; the clay of which it is composed was brought a mile, and was well rammed every four inches, but it has stood the strain imposed upon it remarkably well. Its maintenance has been as important as its construction, and in 1887-88 and 1888-89 considerable extra work was undertaken on account of rough seasons. No engineers care to have such works if they can substitute masonry, but they can be made perfectly safe, and of any size, when the necessity arises. In later permanent works of the kind a thin masonry core has been introduced with great success, but there was no need for this in the Goulburn Valley, where the need is merely temporary. Indian professional men have gained confidence as well as knowledge by experience, and when we find that such an expedient has been adopted in one of the latest of the canals it should need no defence in the colonies.

The Swat Canal was undertaken, not without the expectation of its proving reproductive, in order to protect its district from famine. Its cost was £357,000 when completed in 1885. and by 1887 the wastes into which it had entered, haunted only by the solitary Pathan on the look out for plunder, were covered with fields of waving grain. In 1885-86 it began with 44,000 acres watered, and in 1888-89 reached 107,000 acres, or close up to its capacity. Last year it fell to 91,000 acres, because of a fresh partition of the land being in progress, under which many titles were disputed. Moreover, the exceptionally heavy spring crop of the year before limited the autumn crop of 1889-90. Counting double-cropped land, however, the average of five-sixths of the irrigable land being watered artificially within five years of the opening of the canal is very remarkable. The duty of water obtained ranges between 50 and 80 acres in the kharif, and 130 to 220 acres in the rabi per cubic foot per second, 160 villages being supplied at 5s. per acre, watered in either season. The crops for the last year were valued at £260,000. The millets occupy nearly three-quarters of the hot weather cultivation, and wheat more than half of the cold weather area, of which one-fifth is barley. In the fifth year of its working the canal has paid its expenses, interest on its capital, and £1,300 to boot, so that the prospects of this undertaking, which could never have been considered encouraging, have proved most hopeful.

Of the capital represented in the Panjab by private works employed for artificial watering, there is no estimate available here or elsewhere. The public canals to-day represent an expenditure in this one province, which is only one-third the size of New South Wales, of £7,500,000, of which sum £6,200,000 has been spent in British territory. The old inundation canals represent less than

£150,000 of this sum; the workshops at Mahdopur, £42,000; and the new inundation canals, £430,000. The Swat Canal, though constructed as a famine protection, may be fairly reckoned with the productive works, among which it has now taken its place, so that the present great perennial canals of the Panjab have absorbed more than £4,500,000 sterling. These splendid schemes are, taking them in their order, the Sirhind, Bari Doab, Western Jumna, and Swat, and though the first and last are but recently completed, they yield as a whole 5 per cent. net revenue upon the capital invested in them, which means a profit of between 1 and 1½ per cent. after interest has been paid. It appears to be certain that this profit will increase, for the progress made during the last few years both in works and revenue is steady; the cultivators are annually buying more water and applying it to more land, and there is a considerable margin of both still available upon these schemes, the receipts from which will be nearly all profit. As they will require but little increase of working expenses, there need be no surprise that the irrigation outlook in the Panjab to-day is extremely inspiriting.

A consequence of the past and present successes is that the province is undertaking extensions of its system upon a larger scale than is proposed in any other part of India. One of these, now in course of execution, is a remodelling of an existing enterprise, the story of which offers yet another illustration of the danger of hastily-planned schemes and hurriedly calculated estimates. If the Panjab had not a "boom" such as temporarily existed in Madras and Bengal, it has had its spasms of special activity. One of these occurred in 1882, when the Bari Doab having exhibited a rapid development and the Sirhind works having approached completion, while the finances were elastic, and the need for watering in many districts was confessedly urgent, new projects were called for, and three of them for inundation canals approved and carried out. Two of these, the Sidhnai and Lower Sohag and Fara canals have been already noted. The third (to have its source from the Chenab by means of a branch channel, near the town of Ramnagar, from which it took its name), was to be of modern pattern, to irrigate 144,000 acres each autumn, and command 813 square miles at a cost of £305,000, from which a return of 8 per cent. was confidently anticipated. When construction was authorised it was found that errors had been made in the earlier calculations. The country to be served was a *terra incognita*, the only cross section lines were five miles apart, while the river had deserted the branch from which it was proposed to draw a supply. By clerical errors a bridge of five spans of 20 feet each, and 40,000,000 cubic feet of earthwork, required to bank up the canal, where its bed was so near the surface as to render the spoil obtained from the excavation insufficient, were omitted from the estimates, and as the drainage provided proved deficient £130,000 was asked to complete the project. This was swollen by fresh discoveries, until the additional outlay asked amounted to 60 per cent. of the first estimate of cost. The canal itself had a promising beginning with 10,800 acres watered,

followed in 1888-89 by 47,000, and in 1889-90 by 39,000 acres, the latter year giving a very low river.

From the very first it has been evident that the maintenance of this canal must be extremely costly because of the large quantities of silt taken in by the supply channel in July and August—about 125,000 cubic feet per day—thus endangering the banks and involving heavy disbursements for clearances. It has a flow of 2,350 cubic feet a second, but is liable to receive much more, as in 1886, when the regulator at the head was closed and no less than 1,715 cubic feet a second were poured into it by a tremendous rainstorm. When the canal line was laid out the existing natural drainage channels were noted and provided for, but the experience of the year in question showed how unsafe it was to adopt such a guide to the necessities of the country. The supply channel, 109 feet wide and five miles long, had to be supplemented by an inlet with a fifty feet crest and by a drain seven miles long, 110 feet broad at its mouth and twenty feet broad at its beginning, to divert water direct into the river. The main line, however, was found to be dug in parts through soluble clay, interspersed with nodules of kankar or limestone, which, under soakage, gave way before the water, and was cut into deep gullies by its force. It rained from 6 to 8½ inches in twelve hours in 1886, when instead of the drainage sufficing, the whole country above the canal was two feet under water. It did not run off for three days, and by that time had wrecked miles of the channel. There were 93 breaches, some of them ninety feet wide and eight feet broad, running back 450 feet. It is calculated that in this season 2,250,000,000 cubic feet of rain fell upon the catchment area of 130 square miles, pouring 700,000,000 cubic feet in three days across the canal, with a maximum flow of 4,000 cubic feet per second. Such are the conditions with which irrigation engineering has to cope in India.

As the whole scheme was transformed it offered 125,000 acres of irrigation for £484,000, with heavy maintenance charges and a probable ultimate revenue of about four per cent. A new scheme, a perennial instead of an inundation canal, was strongly pressed by Colonel Ottley, finally sanctioned by the Secretary of State in 1890, and is now in course of construction. The fact that 7,000,000 cubic feet of silt per annum collected in the existing canal, which had but a small fall and commanded but a narrow strip of country, pointed to the wisdom of a fresh site for headworks. It was at first intended to go up as far as Wazirabad, where an extra twenty-six feet of height could be obtained, but the expensiveness of providing for two great drainages led to the abandonment of that position and the selection of Khanki, about half way between the two. The Chenab is a fine river, with a registered minimum flow of 3,884 cubic feet per second, but it is very rarely so low, and has an average minimum in the dry season of 5,000 cubic feet per second. Its high banks are far apart, sometimes as much as four miles; it has the customary Indian habit of changing its channels, and in the stretch, where it is to be bitted, has a fall of 1.66 feet in the mile.

In cold weather its velocity is about 1½ feet a second to 2.7 feet in deep channels, and over three feet a second in flood, when it sends down about 250,000 cubic feet per second. The diversion is being accomplished by means of a rubble stone weir 4,500 feet long, at an angle of 15 deg. upstream of the axis of the river. This work has been more than half built in eighteen months. The escape is to be by a regulator of twelve bays of twenty feet each, on the Sirhind pattern, with the same angle to the outlet as at Narora. A silt deposit of six feet in depth is expected to form immediately below the head.

The weir, like that at Okla, is built of dry rubble stone, with a shallow core wall of rubble masonry, having an ashlar coping fitted with falling shutters, of the pattern of those at Rupar. At forty feet, and at eighty feet, in rear of the crest and parallel to it, are two shallow walls four feet broad and three feet deep, the space between being packed with boulders, having a slope of one in twenty, that of the upstream apron, twenty feet wide, being one in five. The weir has a fall of one foot from right to left. The right bank of the river has been protected by a bund of eight miles in length, twelve feet wide at its crest, and with a slope of one in three to the river, five feet above high flood mark. From this groynes of earth and sand, with crosses of bonded trees, and stone pitching three feet above flood level, are run into the stream. The same spurs are used on the regulator side, while 300 feet of pitching up stream and 100 feet above the return is repeated at the down stream end. The canal will be 109 feet wide, carrying seven feet deep of water, and will permanently distribute the 2,350 cubic feet per second, which the inundation canal only carried for two or three months in the year. It will command 1,038 square miles, watering at least 400,000 acres, though without much expense its supply channels could be increased so as to supply twice that area. Indeed, Colonel Ottley looks forward to the time when nearly 1,000,000 acres will be dependent upon this scheme, which is being completed as fast as energy, ability and experience combined can push a great engineering enterprise in India. It is expected to be in use by April of next year. Although not far behind the Bari Doab and Western Jumna system in its first estimate, it is likely to surpass them in the future, and to become a formidable rival even to the Sirhind, if ever duplicated as its projectors propose. It would then rank among the greatest schemes in the Empire.

So long ago as 1847 the gallant Sir Herbert Edwardes, at the time but a Lieutenant, noted in his diary the condition of the country between the Jhelum and the Chenab, generally known as the Jach Doab. "Two-thirds of it," he wrote, "is an uncultivated waste—called the Bar—want of water has alone kept it fallow till the present day, and it is thinly populated by wide scattered villages of herdsmen and thieves, who tend their own cattle and steal their neighbour's." There, as elsewhere, there are legends of irrigation and prosperity in some remote past; but it has remained as he saw it down to the present day. On the bank of the river is a strip of

khadir, lowlying land from three to fifteen miles wide, supplied either by flood spills, natural or artificial inundation, or wells. The soil is rich, and villages are large and prosperous. Then often, but not always, comes a second strip of country, the Nakka, sloping upwards away from the rivers, where the tillage is entirely dependent upon wells, and where the villages are few and small. When the ascent is sudden there is no Nakka. The high land or Bangar, here termed the Bhar, stretches beyond this to the Nakka of the next river, an inhospitable expanse of jungle in which water lies sixty to ninety feet below the surface, and is often brackish, and where agriculture is only possible in hollows, wherein the scanty rains are caught, and the soil is thus rendered soft enough for ploughing on the chance of ripening by means of uncertain showers. The rainfall rarely rises to eighteen inches, averages twelve inches, and not infrequently falls below this. The dependence of the district is therefore entirely upon irrigation, there being twenty-three inundation channels, of which all but five belong to private individuals. In the Shappur *tahsil*, or district, 327,000 acres out of 344,000 acres cultivated were irrigated. The Doab, as a whole, has 1,374,000 acres capable of cultivation, of which less than one-fourth is under the plough. The Bhar has practically no tillage at all, its few inhabitants maintaining themselves by pastoral pursuits, varied, as of old, with less innocent adventures. Here lie 437,000 acres of Crown lands, upon which the irrigation officers have from time to time cast longing glances, dreaming of the day when their ability should transform the desert into farms.

In its later history the Jhelum project resembles that of the Chenab, except that the latter being undertaken in a primitive form in the first instance attained a precedence which it has since kept. Both have been authorised, but last year the Chenab was accorded the undivided attention of the Department in order to hasten its completion, and until it is finished, the Jhelum must wait. Proposed originally as an inundation canal, the Chenab experience has doubtless operated to encourage the authorities to determine to at once undertake the Jhelum as a perennial canal. In some respects it possesses advantages over the scheme now in progress. The discharge of the river is a little larger, its minimum being 5,000 cubic feet per second; while its maximum, like that of the Chenab, is about 250,000 cubic feet per second; its silt is fertilising in its properties, its drainages are well marked, and few protective works will be required. On the other hand the Jhelum has a bad reputation, even among Indian rivers, for the vagaries of its course. Labour difficulties are common to both, the districts only yielding a little unskilled labour, Pathans and Haazras from the hills, who return to their homes in the hot weather, and whom it is necessary therefore to tempt by high wages, as also the Purbeahs and Urds, who otherwise will not face the burning and thirsty jungles of the Jach Doab.

The Jhelum scheme designated by Colonel Ottley was upon a larger scale than that which Colonel Hume, the late chief engineer, approved, and as reduced is considerably simpler than the Chenab.

The headworks are placed near Rasul, where the Pabbi Hills terminate in a stoney bluff, faced on the opposite side of the stream by the last spur of the Salt Range. Between these a weir 4,800 feet in length, rising 3 feet from left to right, is to be built, two walls of rubble masonry, 20 feet apart, being filled in with boulders, and protected up and down stream by similar material laid in slopes of 1 in 3 and 1 in 5 respectively. The outlet is on the model of the dam escapes used to pass torrents across the Sirhind and Ganges canals rather than on that of their head under-sluices. It has 25 bays of 10 feet each, with 7 feet gates, on the level of the canal bed, except the 10 nearest the inlet, which, for scouring purposes, are a foot deeper in the sill and a foot higher in the gates. The floor is to consist of 3 feet of concrete and 1.5 of ashlar, protected up and down stream by lines of blocks sunk 15 feet below the river bed, and by walls of rubble up and down the river. The down stream talus is to be 125 feet long, 3.5 feet thick, covered by large blocks, and with a slope of 1 in 50, the upstream of the same thickness, 35 feet long, with a fall of 1 in 10. The weir is 6 feet above its foundation, except near the outlet, where it is deeper, and is strengthened by blocks.

The main canal is to run for 78 miles, to have three branches aggregating 83 miles, and with distributaries 730 miles in all. Its slope will be 1 in 6,000 feet; it will carry 2,875 cubic feet per second and irrigate 423,000 acres, one half of the area commanded. This unusually high proportion has been adopted, because in this district the entire cultivation depends upon irrigation, and cannot be eked out by means of wells, while there is no danger of the fields becoming water logged. The estimated cost is £1,250,000, and the work is expected to earn 6 per cent. upon that sum 10 years after it is in working order. It is not stated whether this 10 years is to commence when the canal opens in part, or after the whole scheme is finished, but the difference in any case is only a matter of four years. It is reckoned that it will be six years after the work is started before the first section, embracing the headworks, main channel and some distributaries will be ready for use, and that the subsidiary channels will take four years more to finish. But for the anxiety as to the Chenab scheme, the Jhelum schemes would have been put in hand before now, though, under the circumstances, it is scarcely likely to be commenced for a year or two, or to be opened until the close of the century. It will be capable of great extension if sufficiently encouraging results are obtained upon it, and will probably ultimately embrace some 750,000 acres, irrigated annually by this entirely new scheme, which like the Sirhind, the Swat, and the Ganges canals, the Hindus will owe to the enterprise of the British Government, its command of capital, based largely upon confidence in its capacity to hold the country, and last, but by no means least, its engineers. We are the more likely to appreciate this factor in Australia, as we have had naturalised among us a number of officers who have served on the Indian schemes, including Mr. M'Kinney, the Chief Engineer of New South Wales, and his asso-

ciate, Mr. M'Mardie, Mr. Culcheth, and Mr. Burke, as well as Mr. Derry, of Victoria.

Allowing for the natural development of existing schemes, and adding the totals from the Chenab system, now proceeding, and the Jhelum officially authorised, the Panjab canals, by the year 1900, will represent an expenditure of £10,000,000 upon 15,000 miles of channel, watering over 4,000,000 acres, from modern works which will doubtless, when pressed to their full capacity, irrigate 5,000,000 acres at very little additional expense. The amount of well watering in this province is far less than in the North-West Provinces so that the total is not likely to equal that of the gross area wetted in the Ganges and Jumna Doab and its neighbourhood; but the extent watered by canals is likely to be greater than in any part of India, and the works as a whole to exhibit irrigation engineering in its boldest aspect. How bold and how brilliant that engineering is in India every observer can bear witness, and only the observer can realise. Even then the testimony is insufficient unless that observer be himself an engineer, who has had experience in this particular class of undertaking, since the canals themselves, imposing as they are, conceal innumerable devices by which their efficiency is secured. Taking them together with their surroundings they constitute perhaps the greatest, and certainly the most striking, monument to the practical genius of the British engineer, and to the large minded statesmanship with which his civil superiors have ruled this mammoth Empire of the east, and the hundreds of millions of its people committed to their charge.

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